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# THE VALUE OF RAILROAD IMPROVEMENTS.

*By Morrell W. Gaines.*

When so much is being said loosely of the "valuation of American railways" it is of real miportance and value to gain a clearer idea of the character of the problems it presents and the mode of their solution. The field of engineering economics involved is one of the most interesting belonging to our times, and one inviting more students than have yet taken it up. To its fuller understanding we believe Mr. Gaines' analysis and ably expressed argument will lend material aid.—THE EDITORS.

IN one respect the work of Wellington in formulating his analysis of railroad economics has been a detriment to the free evolution of the science. He did it too well. So great has been the esteem inspired by his deep knowledge and clear vision that his conclusions, in many cases, have continued to hold authority long after the crumbling of the foundation of fact. The metamorphoses of time bring a continual need for fresh analysis. Wellington's great figure has barred the way. Men have lacked the temerity to undo, or to seem to do over again, what he had done so well. As a result the point has now been reached when there is, for practical utility, more to be altered in his conclusions than remains valid within them. His elucidations of principle will always stand as models of inestimable worth. But the superstructure he builds thereon has somewhat lost its application.

In no branch of the science does this stand out more clearly than in the economics of railroad improvements. Wellington's treatment here is light at best, because under the conditions of the time when he wrote, the order of the day was new construction rather than the betterment of existing lines. Extensive development had even then progressed to the point where it necessitated some intensive develop-

ment, but not at all to the degree now observable. The improvement policy was then a rill where now it is a mighty river. Within a few years, during the heavy traffic period that began with 1898, the great systems have each spent tens, and in some cases hundreds, of millions of dollars on betterments. In view of the preponderant, and still growing, importance of the problems of reconstruction, what Wellington has to say about them is all too little. What he does say is not, as it stands, applicable to the changed conditions of the times.

When his work on Railroad Location first appeared, thirty years ago, and even at the time of the revision of 1887, the structure and equipment of railroads were altogether of an order that has passed away. The general adoption of the heavy steel rail, and the introduction of steel and concrete bridges, have brought a new type of track, whose strength is greater than he could have foreseen. The air brake, the automatic coupler, heavier equipment, and the tonnage rating, have given a larger unit of load than he had the opportunity to observe, or could have prophesied. Traffic is denser and the cost per ton mile of haul is less than it was. Finally, on top of the change in all the physical elements of the situation, the fall in rate of interest has altered the relation between carrying cost of new investment and prospective decrease in operating expenses to be secured therefrom. In all respects, therefore, the terms of his problem need restatement.

Individuals have from time to time essayed the reshaping of details, or even of considerable portions of the sum total of the analysis. Much has been done in a preliminary way by those who, like Mr. J. B. Berry after the reconstruction work on the Union Pacific, have given us the rough-hewn synthesis of old and new conclusions used by them as a working hypothesis in meeting their own practical exigencies. But the colossal labor of recasting the whole science of improvement economics *de novo* has remained for the American Railway Engineering and Maintenance of Way Association to take up. That work has only just got under way and it will probably be some years before definitive results are reached. It is with a true sense of its inadequacy, while yet realizing the importance of the book as a contribution to railroad knowledge, that we turn to Professor Walter Loring Webb's recently issued "Economics of Railroad Construction" for a perspective, and a proper viewpoint, in the cursory examination of the accrued deficiencies of Wellington's principal conclusions. The work in question rests on the foundation of the older book, modified by the observations, experiments, and statistics of the twenty years that have elapsed, and to a certain extent by the clear reasoning pow-

ers and ripe experience of its author. It is an excellent compilation and as typical, perhaps, of the existing state of knowledge of the subject as was Wellington's Railroad Location in its day. While not at all to be taken as final or rigorous in its demonstrations, owing to the insufficiency of its experimental basis, it is as nearly final and complete as anything we now have. It will, accordingly, serve as a valid basis for contrast and comparison.

In painting any kind of picture it is not the details but the general composition that conveys the meaning and is the vital essence of the whole. So in describing the relation of improvements to the railroad the important thing is to portray the co-ordination of the main elements, and to show broadly the principal factors of the problem in their proper proportions. Detail must be sacrificed. The treatment, therefore, will be quite simple. No reference will be made to that large class of improvements, such as those to curves, signals, and terminals, which have not for their prime object the increase of the freight-train load. The problem of terminals, which more than any other one influence have come to be the limiting factor in railway growth, is, without doubt, of the very first importance; but it is always an individual problem and not adaptable to the conditions of a general comparison. The freight-train load, on the other hand, is a common divisor of great power with reference to the bulk of both Wellington's work and Webb's—and indeed, to the whole question of improvements in its more general aspects.

Improvements that allow increase in train load earn money by decreasing the number of train miles. The amount a given improvement will earn now as compared with what it would have earned when Wellington wrote depends, therefore, in the main, (a), upon the change in the normal number of trains due to the growth of traffic since that time; (b), upon the change in train-mile expense.

To a certain extent the change in the normal number of trains brings into the argument the history of what has already been done by the average road in the way of improving itself and increasing its train load. For that reason a short *résumé* of the course of traffic and operating conditions since the early eighties is essential as a foundation for the further discussion. The following table, compiled from approximate figures in Poor's Manual for the first three periods, and taken from the Interstate Commerce Commission Reports for subsequent years, shows the change in freight-train miles per mile of line and, as well, the decrease in rates, advance in train load, and increase in traffic density.

RAILROADS OF THE UNITED STATES.

| Year. | Miles Operated. | Freight-Train Miles. Total. | Per Mile. | Ton Miles of Freight Hauled. Total. | Per Mile. | Rate per Ton per Mile, Cents. | Tons per Train. |
|---|---|---|---|---|---|---|---|
| 1882 | 95,752 | 305,118,035 | 3,187 | 39,302,209,249 | 410,458 | 1.236 | 129 (approx.) |
| 1885 | 122,210 | 342,288,770 | 2,808 | 49,151,894,469 | 402,192 | 1.057 | 144 |
| 1890 | 157,976 | 482,900,422 | 3,056 | 79,192,985,125 | 505,095 | .93 | 165 |
| 1895 | 177,746 | 449,291,238 | 2,527 | 85,227,515,891 | 479,490 | .839 | 189 |
| 1900 | 192,556 | 492,543,526 | 2,558 | 141,596,551,161 | 735,352 | .729 | 271 |
| 1905 | 216,975 | 546,424,405 | 2,519 | 186,463,109,510 | 861,396 | .766 | 322 |

From the standpoint of the larger strategy of railroad building and railroad improvement this table compresses within its few lines the whole story of the fall of the period of extensive development and of the rise of a period of intensive development. It shows, clearly and simply, the ruinous financial pressure created by an expansion beyond what the traffic, and the population, would bear, and the relief that has come as a consequence of converting available resources into improvements instead of new construction.

Until shortly before 1900—1899, to be exact—freight rates declined under a fierce competition for tonnage. Until after 1895, ton miles of freight per mile of road remained practically stationary. Both of these results were, directly and indirectly, consequences of too rapid growth. As for operating conditions, the period of improvements not having strongly set in, train load showed but a moderate increase and the ton of freight had to bear a larger proportion of the train expenses than was warranted by the heavily decreased rate per ton mile. From this combination of circumstances—thin traffic, low rates, and high expenses, not to speak of the interest charges of those days—receiverships followed as a matter of course.

After the ruin came the time of repentance, of a strong reaction from the disastrous expansion policy of the preceding twenty years. With the return of confidence there was an abundant supply of capital, the accumulation of several years of forced economy and curtailing of enterprise, awaiting the needs of the railroads at low rates of interest. More than ever before it was within the power of the railroads to choose their course and to build the future according to their will. By one method or another, from the community of interest of the powerful to the lack of aggression of the weak, the railroads of the United States showed that the lesson of defeat had sunk home. New construction, while still active enough to meet the constant need for a living growth, became now very moderate in proportion to the ex-

tent of the already existing mileage. The offensive policy of expansion gave place to the defensive one of betterments.

During these ten years of the new era the change in track and equipment has so far progressed that the average train load has been practically doubled. The influence of the betterment policy is felt in many directions. Rates are better maintained, for a number of reasons to be sure, but fundamentally because the slackening of new construction has allowed traffic to become so thick that it does not need to be scrambled for. The increase of more than 100 per cent in the total volume of freight traffic, from 85 million ton miles in 1895 to 186 million in 1905, is little more than a continuation of the previous rate of increase. But the growth in traffic density from 479,490 ton miles per mile of line to 861,396 ton miles is a complete change, and one that is, probably, unprecedented in the history of American railroading. For from 1895 to 1905 the increase in railroad mileage was only 20 per cent, as compared with 41 per cent in the preceding ten years, 73 per cent from 1875 to 1885, and 95 per cent to 300 per cent in the four previous decades. Since 1895 the pioneer process of building roads to create traffic has been given up in favor of the effort to take care of the traffic that offers on existing lines.

Facilities have been adapted to the doubled density of freight movement, to such effect that there has been an actual decrease in train miles per mile required to carry it. Transportation has been made cheaper. The present great tonnage moves with profit at rates that would not have paid the bare operating expenses in Wellington's time, and that are measurably lower than those which brought bankruptcy twelve years ago. The betterment policy, the making of better lines rather than more lines, has proved itself a necessity to the vital energies of the railroad companies.

Going back now to Wellington: it is apparent that very little alteration is to be made in the valuation of improvements on the score of change in frequency of freight-train movement. Increase in unit of load has kept close step with increase in volume of traffic, so that the number of trains run has remained nearly constant. In individual cases the practice has, of course, varied a great deal. Comparison between the Atlantic Coast Line and the Great Northern, or even between St. Paul and Burlington, would show a wide divergence in the trend of the train-mile density. But on the whole it is to the train-mile expense rather than to the number of trains that we must look for change in the earning power of improvements.

Wellington and Professor Webb approach the subject with forms of analysis similar enough to afford essentially comparable results. Each gives detailed calculations of the value of grade reduction and of the use of powerful locomotives, and each bases his conclusions on the number and cost of the train miles saved. By rearrangement and condensation the following approximately correct comparison can be given of the tables they use as a starting point in discussing the economics of grade reduction:

PERCENTAGE TABLE—IN TERMS OF THE COST OF THE AVERAGE TRAIN MILE. COST OF ONE ADDITIONAL TRAIN MILE DUE TO GRADE.

| | Wellington. Per Cent. | | | Webb. Per Cent. | | |
|---|---|---|---|---|---|---|
| | Normal. | Affected. | Added.* | Normal. | Affected. | Added.* |
| Maintenance of Way.. | 23 | 76.1 | 17.5 | 21.034 | 16.8 | 3.531 |
| Maintenance of Equipment ..... | 17.6 | 17.3 | 3. | 18.024 | 25.1 | 4.514 |
| Conducting Transportation, Unapportioned General Expense ..... | 59.4 | 46. | 27.3 | 60.942 | 71.7 | 43.712 |
| Total ..... | 100. | .... | 47.8 | 100. | .... | 51.757 |
| Interest on Cost of Locomotive ..... | ..... | .... | 1.7 | ..... | .... | 1.5 |
| Total added cost ..... | ..... | .... | 49.5 | ..... | .... | 53.257 |

Professor Webb having confined himself to operating costs, the "Interest on Cost of Locomotive" figure is an interpolation in his table to put the two final results on all fours. Thirty per cent of Wellington's total is "un-apportioned," or non-conformable to the Interstate Commerce Commission classification, and a small portion of that amount should by rights be distributed to the Maintenance of Way and Maintenance of Equipment accounts.

There is a conspicuous difference in the "Per Cent Affected" and "Added Cost" under Maintenance of Way. It is due to a difference in opinion more than to any real alteration in the basic facts. The subject of the relation of the number of trains to the amount of maintenance of way is one that has not been, and, from its nature, perhaps cannot be thoroughly investigated. The weight of the probability seems to incline to the more recent view expressed by Webb. If he is right, that particular method of grade reduction which consists in building a detour, leaving the old track in partial operation, is not nearly so profitable as it would be under Wellington's hypothesis, which is still, in effect, quite generally followed. Ac-

* That is, per cent of the normal average cost attaching to the additional train.

cording to Webb's view the maintenance of the old track would not be diminished by the removal of trains from it to anything like the extent assumed by Wellington.

The two totals of 49.5 per cent and 53.257 per cent agree more closely than would be expected considering the lapse of time and change in operating conditions. It is possible that a thoroughly fresh analysis, one entirely removed from the shadow of Wellington's influence and resting solely upon an experimental foundation, would show a more radical departure. Wellington applied his percentages to an assumed train-mile cost of $1.00—the actual average for revenue trains in 1888, a year after the revision of his book, being $0.96. His figure is conservatively high. Professor Webb puts the operating cost at $1.30, the 1904 average. For 1905 the Interstate Commerce Commission reports it at $1.32, and for 1906 Slason Thompson's compilation gives $1.387. Considering the rise in all classes of expense it would be conservative to call it $1.40 at the present time. This is particularly true in view of the fact that the large freight train probably costs more, all things considered, than the passenger train. Adopting the figures of $1.00 and $1.40 respectively, there is according to Wellington an economy of 49.5 cents per train mile saved; according to Webb (as revised) 74.56 cents, an increase of 50.6 per cent. On one daily train each way saved by grade reduction the economy (for a 100-mile division and year of 365 days) would be $36,135 and $54,429 respectively. Wellington capitalized expense at 6 per cent or 7 per cent, where now 4 per cent or 5 per cent would be sufficient. Then we have the following comparison:

CAPITALIZED VALUE OF A GRADE REDUCTION ALLOWING THE SAME TRAFFIC TO BE HANDLED BY ONE TRAIN LESS PER DAY EACH WAY ON A 100-MILE DIVISION.

| | Based on Wellington. | | Based on Webb. | |
|---|---|---|---|---|
| Capitalized at ..... | 6 per cent. | 7 per cent. | 4 per cent. | 5 per cent. |
| Value ..... | $602,250 | $516,214 | $1,360,725 | $1,088,580 |

The value of a given grade improvement has, on the whole, more than doubled since Wellington's calculations were made. Yet his observations, and even those of an earlier day, are still in effect on many old lines, owing to the inertia of reconstruction. More than that, in spite of attempts to adapt locating work to conditions, they are often employed just as they stand, except for the interest rate, in laying out new lines, and in determining the character and extent of grade revisions. It is common practice to utilize a part, and that generally a major part, of his conclusions.

Discipline and technical training have brought the generality of railroad operations up to a high degree of efficiency. The practical working out of grade economics has not as a rule been attended to with the same degree of skill and completeness. That is not because the matter is complex, for it is essentially simple. But it is of a nature outside the scope of the tactics of railroading which discipline and skill have perfected. It belongs to the higher sphere of management, where success makes requisition alike upon individual initiative, co-operation of directors, good credit, and favoring circumstances. The comprehensive reconstruction of a railroad falls, after all, within the day's work of comparatively few men. Of those still fewer have the free hand and the sense of proportion to work out their improvement policy, even for the moment, into a well rounded whole.

Any road could absorb a practically unlimited amount of capital in improvements before being brought to physical perfection. A part only of the expenditure would be profitable, however, under actual conditions, and of the profitable improvements some would earn more than others. A line improved up to the profitable limit in Wellington's time would have done all work that promised a yield of 6 per cent or 7 per cent, and left undone everything beyond that point. If now this same road were to be reimproved, it would be probable that a large amount of expenditures would be encountered that would have yielded a trifle less than 6 per cent or 7 per cent in those days, and which at the present time, from the comparison above, would accordingly yield 9 per cent or 10 per cent. Construction work is often cheaper than it used to be because of the steam shovel and the locomotive haul. There are, too, many lines in operation which are not properly laid out, even according to the methods and conditions of Wellington's time. Besides, there are usually, in the case of a road which has fallen behind, one or more special imperfections which act as limiting faults to increase the number of trains or to curtail the traffic. Consequently, in instances by no means rare, a very abnormal return is to be obtained on a moderate and judicious investment in line improvements. And on all roads there is a good profit in a constant evolution towards a greater efficiency of track than can be gained by following Wellington.

In comparing the calculations given by the two authors for the value of increasing the tractive power of the locomotive, more difficulty is encountered than in the case of grade reduction. The subject is one whose importance had hardly begun to be appreciated twenty

years ago. There was not then the variety of types of engines to choose from that there is now. Wellington, in approaching the discussion, offers a table showing the increased cost of running larger locomotives, to be combined with the statement already cited for the economy from reducing the total number of train miles, in order to get the net saving of the more powerful equipment. The added cost for a locomotive of doubled weight is 14.1 per cent of the normal train-mile expense. This figure may probably be assumed to vary with the increase of weight of the engine. For comparison with the statement which Professor Webb gives, showing the economy of handling the same traffic with three engines instead of four, the assumed increase in weight of the locomotive may be taken as about 40 per cent, giving an added cost of 5.6 per cent in terms of the normal train mile. Subtracting this from the 47.8 per cent gross economy per train mile saved, there is left 42.2 per cent as the net economy by use of the heavier power. Professor Webb gives 44.787 per cent.

With a train-mile cost of $1.40, Webb's percentage gives a saving of 63 cents for every train mile eliminated. According to Wellington the economy is 42 cents, or just two-thirds as much. A very liberal allowance of a cent per train mile run to cover the capital cost of old engines thrown away would bring the figures down to 60 cents and 39 cents respectively. On an engine running 30,000 miles a year, and saving 10,000 train miles, the annual economy above all expenses, including renewals and capital charges, would be $6,000 and $3,900 respectively. The incentive to increase power as far, and as fast, as the track will stand it has been considerably heightened since Wellington wrote. It was not, however, then a matter that admitted of intelligent dispute. Engines hauling through freight must necessarily be of the most efficient type procurable. The capital cost of the investment in rolling stock is practically a negligible quantity. Where, however, heavy improvements to bridges and road bed are also involved, the same conclusion is to be reached as in the case of the reduction of the ruling grade. The investment should be expanded, under like circumstances, to twice the scale permissible under the calculations of twenty years ago.

There is a general law governing the return on investments referred to by Mr. Jacob H. Schiff two years ago in his testimony before the Committee of the United States Senate on Interstate Commerce. It is to the effect that the average return over long periods on money invested in enterprise, and particularly in railroad enterprise, tends to follow closely the rate of interest at which money can be borrowed

for investment. The competition of capital, whether it be expressed through the laying down of steel rails, or through the mechanism of the common markets for the freight carried, for wages paid and materials bought, acts as a great leveler of unearned, and undue, profits. Save where the original location brings a preferential advantage indisputable from any source, the only way by which a higher than average degree of profit may be assured to a railroad is through the employment of a higher than average degree of skill and intelligence in meeting its operating and engineering problems. It must keep in the forefront of the advance made by roads of its own situation and class, and particularly in all that pertains to physical fitness. It has been shown that the return on properly proportioned improvement expenditures, made over and above what is indicated by Wellington's calculations, tends to be in excess of the rate of interest on the money invested. Per contra, the present rate of return on the money originally invested according to those calculations tends to be less than the rate of interest. For the roads which have attained the highest economy in operation are constantly giving back a part of the results of their efficiency to the public in the form of lower rates and better facilities. This is a corollary of the same universal law, and it penalizes the roads whose efficiency has fallen below the average.

It is for this reason that roads which rely solely upon their original investment are at a disadvantage in spite of low capitalization. It is for this reason that roads like the Southern and the Erie, which have endeavored to modernize themselves, but with insufficiently lavish outlay, have a long, uphill struggle against high operating costs and low net earnings. It is for the same reason, again, that heavily improved or recently constructed lines like Pennsylvania, Union Pacific, and Great Northern, get the utmost out of the prosperity around them, which they themselves have in large measure created. With little apparent effort they go on into an ever strengthening position of power. Improvements are the key to profit in railroading. The need for more, and still more, improvements is insatiable, wrapped up as it is with the development not only of the railroads themselves but with that of the country as a whole. For that reason the casting away of what is now dead in Wellington's admirable analysis and the reshaping of the rest to fit the new problems of the times is a matter of supreme importance.

# AMERICAN TRADE OPPORTUNITIES AND HANDICAPS IN SOUTH AMERICA.

*By Lewis R. Freeman.*

**Mr. Freeman's article is the fruit of eighteen months of observant travel and study in South America, six months of it in the Argentine Republic. American himself, and thoroughly loyal in sympathy, he is frank and impartial in expressing his conclusions, whether favorable or not to national self-gratulation. It is clear that direct but friendly criticism such as this is the very best help in changing past mistake to future success.—THE EDITORS.**

THERE seems to be a very general idea in the United States that, since the visit of Mr. Root to South America, the country has but to step in and reap commercially the fruits of the harvest that our able and diplomatic Secretary of State sowed politically. That we should, and in time shall, supply the greater part of the wants of our southern neighbors is as undeniable to one who understands our manufacturing potentialities as is the fact that, in the light of our showing to date along this line, there has been little to lead to that conclusion one who has only watched our disconnected efforts from the outside without appreciating what is behind them. That is to say, any hopes we may legitimately entertain for future supremacy in South American trade should be based less on what we have done than on what we know we can do when the time comes. The "step in and take" idea of the man in the street is based on nothing but his fathomless American confidence, and, in this instance, an equally fathomless ignorance regarding the true conditions that prevail in the countries in question.

When the time will come for the United States to win its way to first place among the countries exporting to South America involves considerations of economic as well as commercial import. Until the United States is as congested with population as England, Germany, France and the rest of the countries figuring prominently as exporters she will not make anything like the same vigorous effort these countries are making to build up and constantly increase her foreign trade. When that time comes—unless, perchance, we have taken time by the forelock and prepared in advance—we will still have to school ourselves in the infinite details of the task of catering to the wants of a strange people—something that our rivals have spent

the better part of the last four or five decades in mastering. Moreover, we must then have more American importing houses abroad to obviate the present necessity of selling our goods through German or English concerns which, very naturally, give the goods of their own countries the preference; also, American banking houses, of which there is at present not a one in South America. We must also develop and train salesmen who will master the language of the people with whom they are dealing and thus render themselves independent of interpreters, who—and this is particularly true of South America—only too often have understandings with the buyers. Further, our salesmen must give up trying to sell goods after the slap-bang North American system of "take it today for I'm off tomorrow," and accustom themselves to waiting patiently till *mañana* for orders, and then several *mañanas* after that. When all these things come to pass, and when, in addition, we are shipping our goods in fast American steamers—subsidized if need be—which will also give a swift and regular American mail service—then, perhaps, we may be able to scan the table of countries exporting to South America and find the name of the United States without running our finger down the column.

Space, and the scope of this article, will not permit a discussion of these essential "conditions precedent" I have enumerated, and only a brief amplification of one or two of them. One of our worst handicaps today is the almost total absence of large American importing houses. In the city of Buenos Ayres, with its 1,200,000 people and a trade equal to that of any four other ports of the continent, with the exception of a threshing-machine company dealing exclusively in its own products, there is not a single prominent American firm. Our goods are imported and sold principally by the big English and German houses, several of which do a larger business in American lines than in goods from their own countries. This latter fact has been due almost solely to the marked superiority of the goods—mostly argricultural machinery—rather than to any vigorous pushing they have had from the agents.

In Chile, one of the two most prominent importing houses is American; but the manager and heads of departments in the main office at Valparaiso are English, and, out of several score of clerks, only three or four are American. The Concepcion manager of the same house, and all his assistants, are English, while the Valdivia manager is Norwegian, and all under him Germans.

There are several reasons for this state of affairs, and the principal one, briefly stated, is that, until conditions in the United States force American manufacturers to seek foreign trade after the manner

of their European rivals, a man with the executive capacity to be worth, say, $15,000 a year at the head of a branch abroad will be able to command twice that sum at home. With the necessity of building up a foreign trade, the value of his services abroad will continue to increase while his value at home will probably fall off, or only remain stationary at best. When, and not before, the American manager is worth more abroad than at home, the country will be properly represented commercially in foreign countries.

In the matter of salesmen we must have men who not only speak the language, but who are also thoroughly conversant with the customs and idiosyncrasies of the people with whom they deal. The South American, in his buying as in almost everything else, is a most deliberate person as well as a very sensitive one. A salesman who will call, smoke a cigarette, talk inconsequentially about the weather, the theater, and the races, and answer questions—should any happen to be asked—rather than make assertions about his goods, will outsell, five to one, the livest hustler that ever opened up a sample case. This is a thing so contrary to the very instinct of the American salesman that, to date, in his wanton disregard of it, he has constantly played into the hands of his more experienced European rivals. "Your Yankee drummers," say the later politely, "are the greatest salesmen in the world—in America."

Banks and long credits have been urged so frequently, and their necessity is so obvious, that there is nothing new to be said on the subject. As for subsidized steamship lines, the strongest argument in their favor is found in the fact that Kaiser William credits them with being the principal factor in the swift closing-in of Germany upon England in her export trade.

In the race for supremacy in South American trade, sentiment is a thing which the United States must leave quite out of the reckoning; for where sentiment exists in the southern republics it is more often unfavorable to us than otherwise. Only in Peru, Ecuador, Bolivia, and Brazil do we stand on the same basis of popular regard as our rivals. In Uruguay, Argentina, and Paraguay we are disliked, in Chile and Venezuela hated, and in Colombia, detested. In the three latter instances our unpopularity has largely arisen from specific incidents, such as the Baltimore affair at Valparaiso, and the secession of Panama; but running deeper, and pervading most of the peoples of the continent, is a more or less thinly veiled dislike of the American personality, which is the very antithesis of their own, a jealousy of American power and prosperity, and a distrust of American intentions as embodied in the Monroe Doctrine. As a result of

Mr. Root's visit some of these feelings are in temporary subsidence; but, in general, they were too deeply seated to allow much hope that they are permanently eradicated.

From the foregoing it will be seen that we still have a long road to travel, and one beset with many obstacles, before winning our way to the goal of South American commercial pre-eminence. Far from being a "step-in-and-take" proposition, there is nothing for it but to "buckle down and fight." A certain amount of racial prejudice there is always going to be against us, probably sufficient of it to offset any advantage of geographical position we now enjoy, or even those that will come with the completion of the Panama Canal. After first placing ourselves as nearly as possible on an equality with our European rivals in the matter of facilities for transporting and selling our goods, we must make our winning on the sheer superiority of the goods themselves. In certain lines—principally shoes and metal manufactures of the type-writer and cash-register class—we have already established an easy lead in spite of all handicaps, and in several other lines we are rapidly gaining ground. What has to be done to attain this success, what can be done, as well as the difficulties attendant upon the doing, are clearly illustrated in the experience of one of our largest threshing-machine companies.

Ten or twelve years ago, when these people made their first effort to introduce their machine into Argentina, that country's demand for threshers, and all other agricultural machinery, was supplied by English manufacturers with strongly-built but—in comparison with the American article—hopelessly out-of-date machines. The relative value of the most popular English thresher and the American machine in question might—and may still—be judged from the following brief data, the authenticity of which I have carefully confirmed by personal inquiry and observations in the field:

The English machine and engine weighed several thousand pounds more than the American, cost about a third more, and, under equal service, lasted about a third longer. The American machine, with half the number of men required to serve the other, would accomplish twice the amount of work in a given period. Thus, the considerations of "life" and cost practically offset each other, leaving the advantage of weight in favor of the American machine, in addition to which the greater economy and superior efficiency of the latter figured out at about four to one.

In spite of these advantages—repeatedly demonstrated whenever it had a fair trial—the American thresher languished for several years in an English importing house, which, incidentally, also sold

English machinery, and few sales were made. This was due not only to the failure of the agents to recommend it fairly, but also to the fact that a large number of the great *estancieros* of Argentina were English, and of the type of that good old Briton who swore that he would turn back from the golden gates themselves if he failed to find the Union Jack waving over them. Most of these ranchers, at that time at least, would have cheerfully gone down to failure rather than win success by using a "cute Yankee contrivance," and the Argentiños, who have a great and not unfounded respect for British judgment, displayed a similar contempt for the new machine.

After a long period of loss and discouragement, the American company, as a last resort, established a branch of its own in Buenos Aires. A number of the best machinists in its employ were sent down and every machine sold was not only set up, but also delivered, and operated for at least two weeks, under the personal direction of one of these experts. If the buyer desired, an American engineer was supplied, at a moderate cost, for the whole season. The company provided all its men with competent interpreters, but at the same time did all it could to encourage them in learning the language, while handsome bonuses were also paid those willing to renew their first season's contract and continue their work in Argentina.

Without tracing through the years the record of the phenomenal success that followed the inauguration of these radical departures, it will suffice here to say that the company in question sold last season more machines than all the English and German companies combined, and that following close behind it in the matter of sales came two other American companies which have adopted somewhat similar methods of introducing their goods. The trade of the native Argentiño in every class of agricultural machinery is now practically monopolized by American concerns, though the British ranchers, as a class, still stand gamely by their English models.

But outside of the splendid showing we are making in agricultural machinery, light metal manufactures, shoes, and a few knick-knacks, there remains the whole long list—including everything imported by a rich and progressive people—in which we are hardly figuring at all; and the most important article on that list is railroad supplies, our specialty. Argentina, next to the United States (and, possibly, Russia), is destined to be the greatest railroad country in the world, and already her mileage is but little short of that of all the rest of the Southern Hemisphere combined. On every line in that country I saw, from time to time, various antiquated specimens of American rolling stock, but little that could, by any stretch of that

term be characterized as modern. Having in mind the fact that the general conditions to be met by a railroad in that country are so nearly identical with those that obtain in the United States that most of the freight and passenger cars, though of English manufacture, are of American pattern, I asked a prominent railway official how it was that they were no longer buying in North America. He smiled an amused smile of reminiscence, and then told me what I have since learned is the Argentine railroad man's stock story when the subject of American rolling stock is brought up.

"I was traveling on a train in Mexico a few years back," he said, "and in an adjoining section were seated two men whom I judged from their conversation to be American railway officials. Our car was an untidy, stuffy affair of an obsolete design, commenting on which fact one of the gentlemen, after roundly rating the company for compelling people to travel in such state, ended up by exclaiming disgustedly: 'The "Central" people should have discarded such junk as this years ago; they needn't necessarily have scrapped it, but they might at least have sold it to one of the Argentine roads and got it away from civilization.' "

For the benefit of those not familiar with the lines of Argentina I will state that the joke in this, from the standpoint of the railroad men of that country, lies in the fact that their average equipment is easily up to that of the American roads.

This proclivity of Americans, not only in thought but in practice as well, to consider Argentina as a dumping ground, has done our trade more harm in the last twenty years than proper recognition can undo in the next fifty. Operative, also, in preventing the railroads from buying in America has been the fact the freights are higher than from England and the steamer service far less regular.

The circumstance that nearly all the Argentine roads are owned in England would, in any case, other things being equal, cause their equipment to be bought in that country. The point I am coming to here, however, is that I have been assured on every hand that things are not equal; that much of our rolling-stock, even when new, did not give the service of that English manufacture, and that today, between locomotives of equal age, those of England are more economical and in better condition than the American importations.

During eight months spent between Argentina and Uruguay, in which time I traveled over nearly every mile of railway line in those two countries, and talked with every class of employee and official from greaser-boy and section-hand up to manager and president, I made written note of all the opinions expressed on American rolling-

stock and kindred machinery. This heterogeneous mass of evidence—most of it unfavorable—I reduced to its lowest terms by the elimination of repetition and similar criticism as much as possible, and submitted the salient points for expert comment to a gentleman whose wide experience on South American railroads makes his opinion practically authoritative on the subject in hand—Mr. P. Seagfield, locomotive superintendent of the Central Uruguay. His report, which I append herewith in all its essentials, I regard as the nearest approach to an unprejudiced comparison of English and American railway equipment as found in South America that it is possible to obtain from an English-trained railway man. Unfortunately, there are no Americans on the ground who may be consulted in the matter; hence any reply—general or specific—to the criticism which follows must come from North American railway men.

Mr. Seagfield's own experience with articles of American manufacture is fairly extensive, his road having among its rolling stock a number of locomotives, carriages and wagons which were supplied by American firms. He says in part:

"LOCOMOTIVES.—When we took over the Western Railway (in 1900), we received nine engines of American build, all of the four-wheel coupled simple type, with tenders carried on two four-wheeled bogies. Six of these had cylinders 17 by 24 inches and 5-foot 3-inch driving wheels. The remaining three had cylinders 15 by 24 inches, the driving wheels being the same size. As taken over by us the engines were all practically new, some of them not having been even erected, and we have worked them ever since, that is to say for the past five or six years, but the experience I have gained so far would not induce me to perpetuate the type in competition with English-built engines, which we much prefer.

"Some of the defects we have noted are as follows:

"ADHESIVE WEIGHT.—The engines are generally wanting in adhesive weight in relation to the size of the cylinders, and this coupled to want of stiffness in the bar frames causes a tendency to slip, especially in starting a heavy train.

"COAL CONSUMPTION.—The engines are undoubtedly heavier on coal consumption per vehicle hauled than their competitors of English build, though I have not found the difference to be so large as to hinder our making considerable use of the engines. Regarding the cause of the increased consumption, I am inclined to think that in the first place the steel fireboxes have something to do with this. All English engines are fitted with copper fireboxes, the superior heat conductivity of which is an advantage. Another cause is the greater

expansive working of the steam in the cylinders in the English engines, and although I find that the American valve gear gives a fairly wide range, in the normal working position of the engine the cut-off is not so early.

"After running the engines for a short time we came to the conclusion that the orginial exhaust nozzles of the double type created undue back pressure, and we changed them for single nozzles of English type, thus considerably increasing the area, with apparently beneficial results, as while the coal consumption for six months ending June 30, 1900, averaged 1.67 pounds per vehicle-kilometre, this figure had dropped to 1.35 pounds for the six months ending June, 1905.

"GENERAL WORKMANSHIP.—We have had cases of breakdowns with these engines which according to English standards would be classified as attributable solely to defective workmanship or material. For instance, valve-stems have broken off close to the buckle, due to defective method of welding. The crossheads, which together with the small end pin of connecting rod are in one casting of iron, have given trouble owing to the small end pin breaking, and splitting has occurred through the cotter-way which secures the crosshead to the piston rod.

"AXLES.—All axles of these engines were of wrought iron and they soon developed laminated flaws, and, commencing with the bogie axles which gave out after a very short life, we have had to renew them throughout. In the case of the tenders this involved, as well, the renewal of the original cast-iron wheels by cast-steel centres fitted with hard tyres, owing to the fact that the cast-iron wheels developed flaws and flat places after a very short life.

"BRAKE GEAR.—The tender brake-gear was of very flimsy construction, the brake beams being of wood and iron flitched, and owing to its general lightness of construction we have had to renew and modify the arrangement throughout.

"SMITH'S WORK.—Generally speaking all smith's work is of a cheap and rough description and cannot be compared with corresponding work on an English-built engine. Welds are particularly badly made, and I may instance the arms of the rocking shaft of the reversing gear which, instead of being a solid forging with the shaft, are simply dabbed on.

"BOILER AND FIREBOXES.—The workmanship of the boiler is good, and leaves little to be desired, but we have found a want of uniformity in measurements. When it became necessary to renew the fire bars we found that those which fitted one engine would not go

into another of the same class, owing to there being differences of upwards of 1¼ inches in length of the fireboxes in what are nominally sister engines. The trouble that this will entail when fireboxes have to be renewed will be considerable, and will, I expect, decide us to scrap the engines sooner than would otherwise be the case.

"CYLINDER CASTINGS.—These are both good in material and workmanship, but the exhaust passages, owing to their form, get water-logged, and we have found it necessary to fit automatic relief valves.

CARRIAGE STOCK.

"We have a few bogie carriages of American build which were taken over with the North Eastern Line, but they are now upwards of 30 years old and do not represent contemporary American practice. They were, nevertheless, well built, which is demonstrated by the fact that we still make use of them alongside of our more modern stock, and we have nothing today which forms an easier or better riding coach.

"FREIGHT CARS.—We have a small number of open, flat freight cars and a few covered ones. There is nothing much to be said against these except that in the matter of the English draw and buffer gear with which they are fitted, the wrought-iron work is of an exceedingly rough character. On the other hand, I may mention that the springs appear to be exceptionally good, and I have found this to be the case whenever dealing with American springs for rolling stock. The roofs of the covered wagons were originally of wood, double thickness, the top boards overlapping the joints of the under ones, but the arrangement started to give trouble by leaking and we have since had to replace the roof boards by corrugated iron sheets.

"BOLTS AND NUTS.—These as applied to articles of American manufacturers in general are a source of trouble when such articles are for export, owing to the fact that the size of the nuts and pitch of the threads correspond to American or Sellers' standards, whereas, outside of the States, the Whitworth's standards are those most commonly in use. The result is that, as bolts and nuts are very often the first articles which require renewal, we find that these have to be replaced by our Whitworth's standards and this often involves spanners having to be duplicated, to say nothing of the fact that possibly, when only the renewal of a nut is involved, the bolt has to be thrown away as well, owing to the difference in pitch of threads.

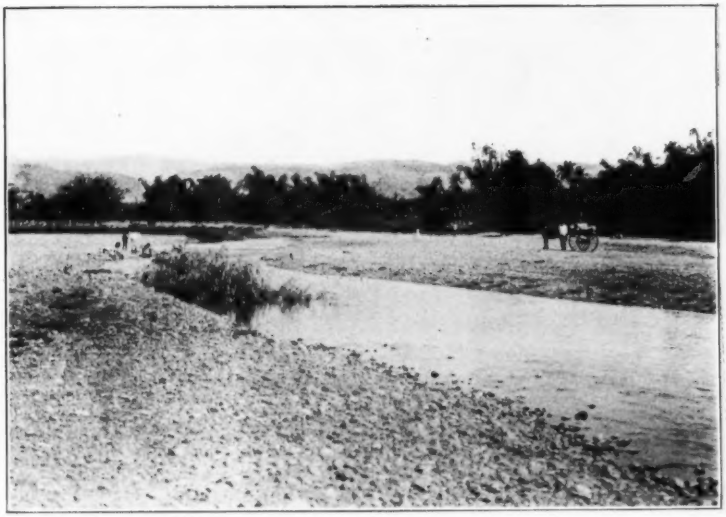
"MACHINE TOOLS.—I have little or no experience of these, but have no doubt that nowadays the Americans turn out some very fine

machinery. As a matter of choice I should prefer Anglo-American machinery—that is to say, tools embodying American ideas, which are often very ingenious, but manufactured according to English ideas of solidity and thorough workmanship.

"WINDMILLS.—I have had some experience of these of American make during the past five or six years, but can say nothing in their favour, as they have given us endless trouble in the matter of repair and upkeep, owing chiefly to an entire want of proper provision for renewal of wearing parts and also to absence of efficient means of lubrication.

"GENERAL REMARKS.—As you will see, I have little to say in favour of American manufacturers in general, and I think the reason for this in the matter of locomotives and machinery is not far to seek. In the first place American designers of locomotives, until recently, have been conservative in their designs—it being unusual for a manufacturer to depart from his settled types—with the result that practically the same engines as used in the States have been supplied to other countries, irrespective of the local requirements. On the other hand, English capital has built and controlled railways in all parts of the world, and the suggestions of the engineers working these lines have been transmitted home and further elaborated by their consulting engineers, who had current knowledge of the special requirements encountered, which enabled them to arrive at designs suitable to the working conditions of the different lines. The lightness of details in the American engines is against them, and while it is an easy matter in the States to renew these cheaply, this does not hold good when the engines are exported to foreign countries, and to order ready-made details from home is a costly matter which entails the laying out of money that might remain idle for an indefinite period.

"There is, too, a prevalent idea that the roadbed of the South American railways is of a primitive description, consisting mainly of sleepers thrown on to the soil to which the rails are spiked, and that, in consequence, refinement in the fittings and finish of rolling stock is out of place: in other words, the looser things are put together the better they will fit the road. This is a mistake, at any rate in the case of the Central Uruguay Lines, the roadbed of which is of excellent description and ballasted throughout with stone ballast, and the solidity of this construction very soon finds out loose fittings and general weak construction.



MANANGA RIVER, WHICH WILL FURNISH GRAVEL AND SAND.

# THE RAILROAD DEVELOPMENT OF THE PHILIPPINES.

*By P. H. Ashmead.*

The lack of industrial advantage through occupation by the United States has been stated to be one main cause of discontent in some parts of the Philippines. Mr. Ashmead's article is most interesting in showing how active a feeling of satisfaction has been awakened where manifest industrial advantages have been offered. This aspect of his review is perhaps quite as important as the account of the physical progress of the work.—THE EDITORS.

EIGHTEEN months have elapsed since the Government railway projects in the Philippines took shape through the award to the Philippine Railroad Company of a perpetual concession for building, equipping and operating between three and four hundred miles in the Visayan Islands, and of a contract, similar in size, to the Manila Railway Company on the Island of Luzon. The Philippine Railway Company will complete and equip its lines in four years according to a standard to be agreed upon with the Philippine Government, the Government in turn, by act of Congress, guaranteeing the interest of the thirty-year bonds of the Company at 4 per cent. Thus this concession is stamped at the outset with the mark of United States Government approval and guarantee of support.

THE RIVER FRONT AT ILOILO, THE METROPOLIS OF PANAY.

The undertaking of the Manila Railway Company is essentially a private one, the concessionary syndicate being almost entirely British in personnel and interests concerned. American capital is going into the Philippine Railway Company, and British and other non-American capital into the Manila Railway Company. The Government originally proposed that only Americans should participate in the railway development of the Islands, but the representatives of the Manila Railway Company were already installed on the ground in the old Manila & Dagupan Railway and were so keenly alive to the new railway situation and its possibilities that they succeeded in securing a part of the work, considered by many to present as great opportunity for development as the part held by the former syndicate.

On April 29, 1906, a party of fifty American engineers, organized by J. G. White & Company, the constructing engineers for the Philippine Railway Company, sailed from Seattle to undertake this greatest work of industrial development ever promoted by the United States in the Far East. On June 14 they landed, and the leaders all having been selected for experience in the tropics, no time was lost in beginning surveys.

Upon his first inspection of the ground after his arrival, Mr. E. J. Beard, chief engineer of construction, and formerly principal assistant engineer of the Rock Island, verified most of the preliminary report on resources and location submitted by Mr. L. E. Bennett and published in the form of articles in THE ENGINEERING MAGAZINE for May and June, 1906. With all of the original location tentatively laid down he did not however accord. The first exact surveys on Panay demonstrated a 1 per-cent route between Dao and Passi on Panay, where the Government route called for a maximum grade of 2 per cent. A further change suggested in the Panay railroad was a 15-mile extension west from Jimeno, on the north coast near Batan, to Calivo, tapping a very rich valley having 70,000 inhabitants and producing quantities of hemp, copra, etc., which could advantageously be hauled to Batan or even Iloilo. The original location made a terminus of Batan.

On Negros the original tentative route ran up the west shore from Cabancalan to Victorias, and then bent east along the north shore and terminted at Escalente, 38 miles from Victorias. After looking over the situation, the chief engineer was of the opinion that it would be better to substitute for this section another running southwest through the valley of the Ilog River, which would tap a region rich in timber and more thickly populated than the north.

Notwithstanding the handicap of survey work in a tropical climate through the wet season, the task in hand was unremittingly pursued, the five locating parties vying one with another to achieve the best showing, and in November, 1906, ground was first broken on the Island of Cebu and the actual construction began. Now a second wet season is upon the builders and there is a slight lull in activity which affords opportunity to review the accomplishment of the year.

ENGINEERS' QUARTERS, ISLAND OF CEBU.

On Cebu the surveys have been completed for the 100 miles contemplated, grading is completed upon 35 miles and track has been laid on 27 miles. Operation will shortly be inaugurated on the 20-mile section of the Cebu railroad from the city of Cebu, the busy metropolis of the Southern Philippines, to Danao, the northern terminus. One of the first steps in the construction was to grade and lay the rails on the 7 miles out of Cebu toward the Mananga River, tapping a gravel bed that has supplied ballast for most of the northern half of the line. All the main line from Cebu south to Argao has been located, as has the branch line across the island from Carcar to Barilli. About 4,000 workmen have been employed on Cebu.

On the Island of Panay, where 110 miles of road is being built, the surveys have been completed and construction is well along. The 1,500 workmen now busy on this island show a progress that averages well up with that on Cebu, making due reduction for the somewhat

easier country. Four months after undertaking construction the grade was established from Iloilo, the southern terminus, nearly to Pototan, 20 miles north in the interior. Rails are laid 6 miles out of Iloilo and surveys have been made for the additional mileage along the north coast of the island, the construction of which is recommended by the chief engineer, as before noted. With respect to operation, it has now become a question whether the first 20-mile section on Panay or the second section on Cebu will first be ready.

Construction has not yet been begun on Negros, but the surveys of the line originally proposed by the Government along the west coast from Cabancalan through Saravia to Victorias and along the north coast from Victorias to Escalente—108 miles in all—are completed.

A CAMP LOADED ON BULLOCK-CART TRAIN, CEBU.

Just what percentage of the work of the whole system from the commencement of survey to the inauguration of operation throughout has been executed is difficult to estimate exactly, but it may quite safely be figured, counting both survey and construction, that a full one-quarter has been done, even making no allowance for the fact that this first year includes an investment of time in the mustering, training, and organizing of absolutely raw labor that will pay a very high rate of interest for the remaining time.

With the Manila Railway Company on the Island of Luzon

construction is progressing satisfactorily, but it may be some little time before any considerable portion is ready for operation. The new roads in Luzon are divided into three principal trunk sections with no less than ten small branches. North, in Benguet Province, there is a 40-mile extension of the Manila & Dagupan road from Dagupan to San Fernando. South from Manila, in Cavite and Batangas Provinces, there is a 70-mile division extending to the town of Batangas on the southwest coast. Again down in the extreme southeast toe of the Island, in Albay Province, there is a 60-mile section between Pasacao and Albay—entirely separated from the extensions of the present main line. The remaining 200 miles is divided among the ten small sections before noted. Judging from latest reports it would seem that about 15 per cent of the new roads on Luzon have been completed.

The problem of the selection of equipment and rolling stock, because of the total lack of experience available regarding the operation of railways in the Visayan Islands and the small fund of knowledge in other countries where analogous conditions obtain, has demanded the exercise of the best judgment of the railroad men and financiers at the head of the undertaking. To insure the selection throughout of the best adapted rolling stock and equipment, there has been formed in New York a technical board, composed jointly of officers of the railway company and the constructing com-

CLEARING THE RIGHT OF WAY THROUGH THE CANE FIELDS.

THREE WEEKS' GROWTH OF NIPA ALONG THE RIGHT OF WAY.

pany and two consulting railway experts, which coöperates with the two chief executives of these companies in the field. The original concession provided for the gauge, which is 3 feet 6 inches, and subsequent questions of construction, equipment and operation have been left to the directors of the Company, the Technical Board, and the Philippine Commission.

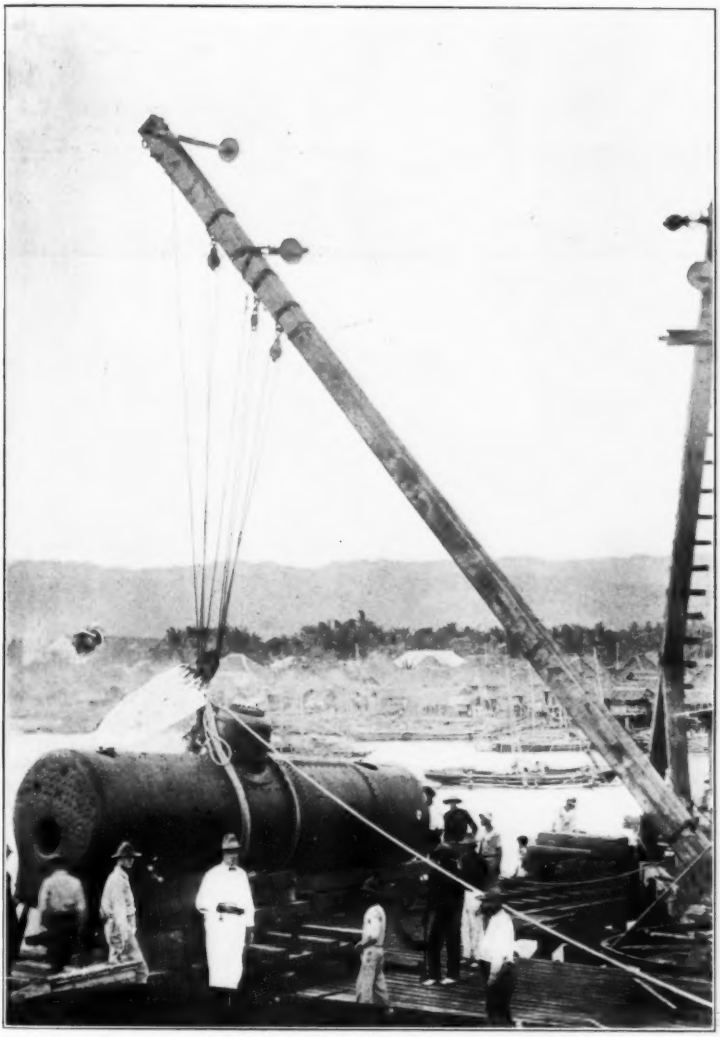
Shortly after the arrival of the first engineering party, early in the summer of 1906, the first consignment of rolling stock and equipment was ordered upon recommendation of the chief engineer of construction. It consisted of four 50-ton Mogul locomotives, to be used first on construction and later for operation, a number of small construction engines, fifty 40-ton flat cars, and fifty changeable ballast cars. Four thousand tons of 70-pound A. S. C. E. steel rails and accessories were ordered at the same time. The Mogul locomotives are exceptionally powerful for narrow-gauge engines, weighing in working order with the tender 92 tons and having a tractive effort of 21,000 pounds. They have 50-inch drivers, straight-top boilers 62 inches in diameter, and 17-inch cylinders with a 24-inch stroke. A high-carbon native lignite coal found on Cebu is the fuel for which the locomotives were designed and they are provided with diamond stacks similar to those successfully used for lignite burning on the Union Pacific.

Spark arresters are provided to prevent setting fire to the *nipa* thatch roofs of the native dwellings. The tenders are of the Vanderbilt type holding 8 tons of fuel and 4,000 gallons of water. For six months now these four engines, with the smaller ones used in grading, have been doing yeoman service, particularly in hauling heavy trains of ballast from the gravel pits at the Mananga River.

A FILL, CEBU.

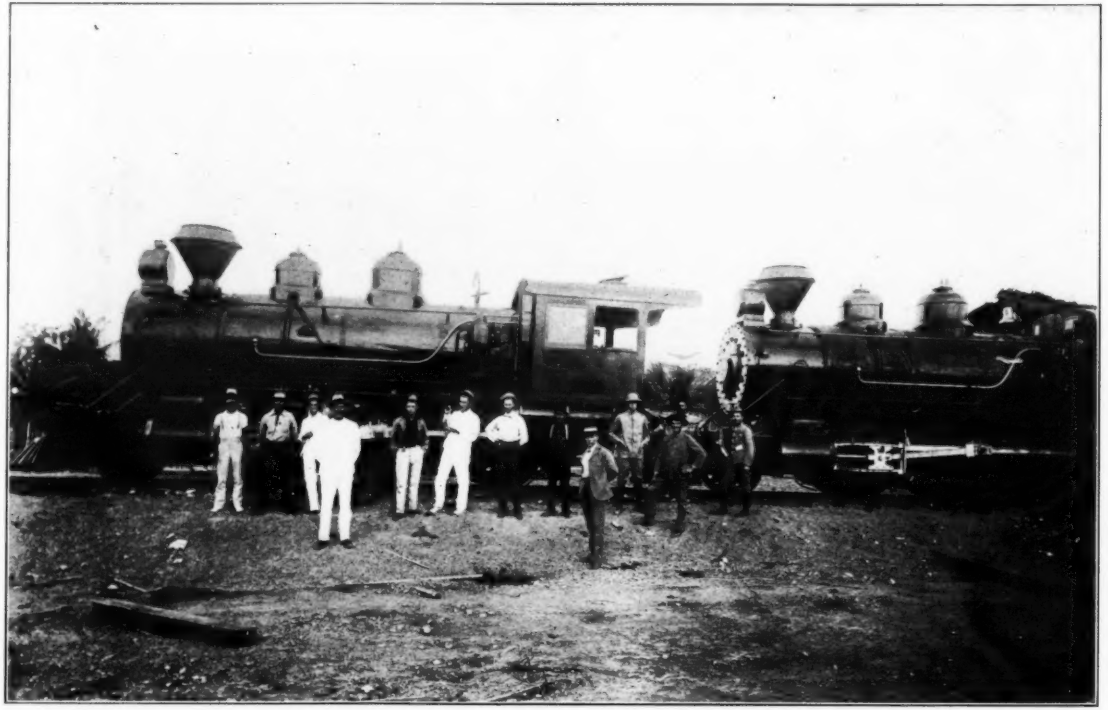
A second call for rolling stock and material was sent in early this spring, this time including passenger equipment to insure its delivery by the time of beginning operation in Cebu and Panay. Six more Mogul locomotives of the same general design as the first four but somewhat lighter were ordered, together with four combination parlor and first-class cars, four combination mail, baggage, and third-class cars, and fifteen third-class cars. These passenger cars are to be 49-feet long over the buffers. The additional freight equipment in this order was forty 20-ton box cars, forty 10-ton cars, and four cabooses. Four thousand tons more of rails and 4,000 tons of bridges were sent for about the same time.

The design of the passenger cars demanded of the Technical Board more consideration than any other topic and there are still to be settled numerous minor points of finish and fitting. Such factors as the best number of classes to be adopted, the exact requirements of



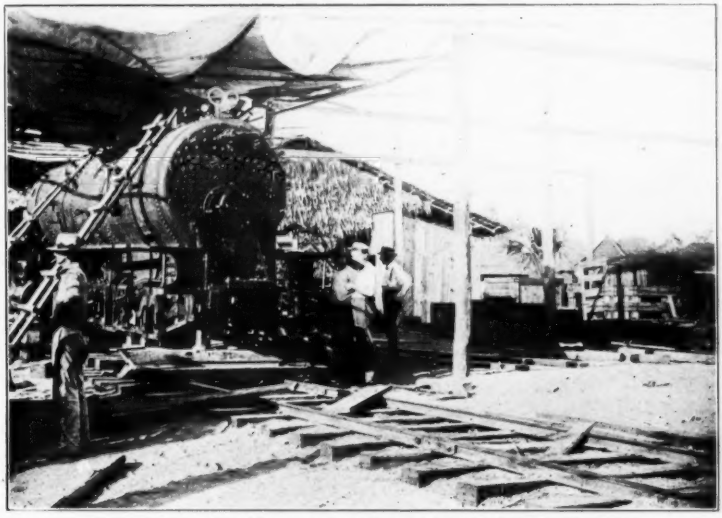
UNLOADING A LOCOMOTIVE BOILER, CEBU.

the natives in each class and of foreigners traveling in the tropics, the choice of the materials of construction which will best withstand the climate, etc., has to be duly weighed. The trucks are being made



JUST FINISHED SETTING UP, READY FOR STEAM.

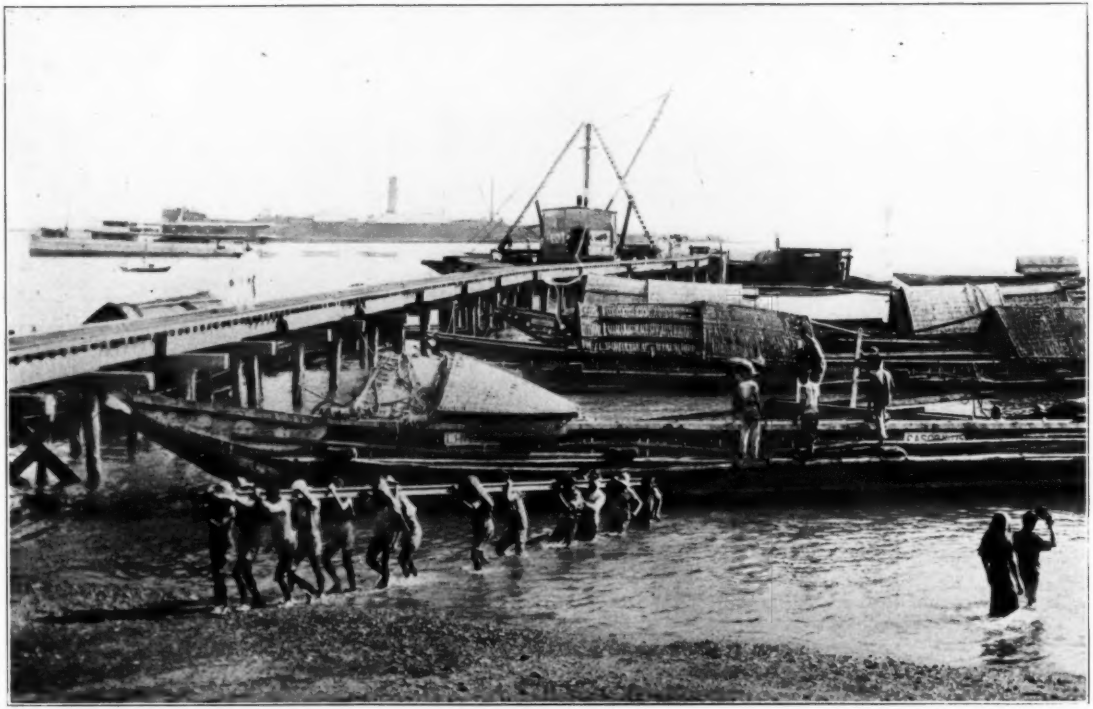
to standard designs, the floor frames are to be steel, and the woodwork within and without is to be teak with a natural oil finish. No other wood will resist the ravages of the teredo and white ant, and paint is not sufficiently lasting for the climate. To aid them in selecting the best design of passenger equipment the Technical Board has conducted examinations of current practice on many great railway properties in the tropics, such as the Great Indian Peninsular Railway, the Natal Government Railway, Le Chemin du Fer du Congo, and the Sudan Government Military Railways.



SETTING UP LOCOMOTIVES FOR THE PHILIPPINE RAILWAYS, CEBU.

In the solution of the difficulty of securing rapidly sufficient quantities of ties to keep up with the rest of the construction and equipment, the engineers in the field gave a characteristic exhibition of the resourcefulness and vigor with which the work is being pushed. Australian jarrah ties to the number of 150,000 annually were contracted for, but furthermore, down into the island of Mindanao where it was known that suitable woods grow in abundance there was sent a representative who successfully bargained with His Majesty Datto Piang. The Datto turned some hundreds of his men loose on the job with their native knives and some imported saws, and it is probable that a constant and adequate supply of ties and piles will result.

Naturally no factor in the building of the Philippine Railroads is so interesting as that of labor, for only Visayan natives have been



NATIVE LABORERS UNLOADING RAILS FOR PHILIPPINE RAILWAYS, CEBU, P. I.

used and the experiences encountered must afford a sound basis for judging the mental and physical fitness of the Filipino people to meet the demands of modern industrial progress. Before construction was begun the opinion was quite generally current, among Government officials and business men well versed in the general affairs of the Islands, that the railroads in the Visayas at least could not be built economically or expeditiously save through the importation and general employment of foreign labor, ostensibly Chinese. This belief has never been shared by the executive officials of the construction company. Since the successful adaptation of the natives to the more difficult or rather more technical engineering work connected with the Manila electric street railway and power house, full confidence has been felt in the ultimate proficiency and reliability of Filipino labor.

COMPOUND NO. I, ISLAND OF CEBU.

So, despite opinions, the policy of depending solely on Filipinos resident in the Visayan Islands was adopted, and never has a policy adopted under the shadow of a serious doubt "made good" more effectively. On Cebu, the most thickly populated of all the Philippine Islands, no question has ever been entertained by Mr. Beard or his assistants as to the success of the policy; but they did feel that construction forces for less densely populated Panay might have to be imported from Cebu and other islands, but so far this has proven unnecessary and the progress has been hardly less pronounced on the

second island than on the first. It is still felt that Negros, the least densely populated island of the Visayas, upon which construction is still to be begun, will demand an importation of labor from Cebu or Panay, but it is not improbable that here again the native sons will rise to the occasion quite as before.

Cebu presents the fairest opportunity to estimate the capacity of its indigenous workers because the construction has been pushed most rapidly there. Within three months the forces composed of men

NATIVE TRACKMEN IN THE MATERIAL YARDS AT LAPUS LAPUS, PANAY DIVISION.

brought fresh from the plantations where they had never known the use and convenience of modern tools and appliances were able to proceed with the grading using picks, shovels and wheel-barrows, at the rate of 110,000 yards per month, an average of 30,000 yards being rock, drilled by hand. Grades of 4 feet are thrown up without difficulty by the little fellows. And these results were attained despite the fact that the white foremen have left a great deal to be desired, being mostly such representatives of the Republic as could be found in the Islands unattached by contract to any regularly established business or industry.

In managing the rank and file of the workmen, but one difficulty worthy of notice has commanded the energies of the executive staff in the field. The workmen all profess religion intensely and they

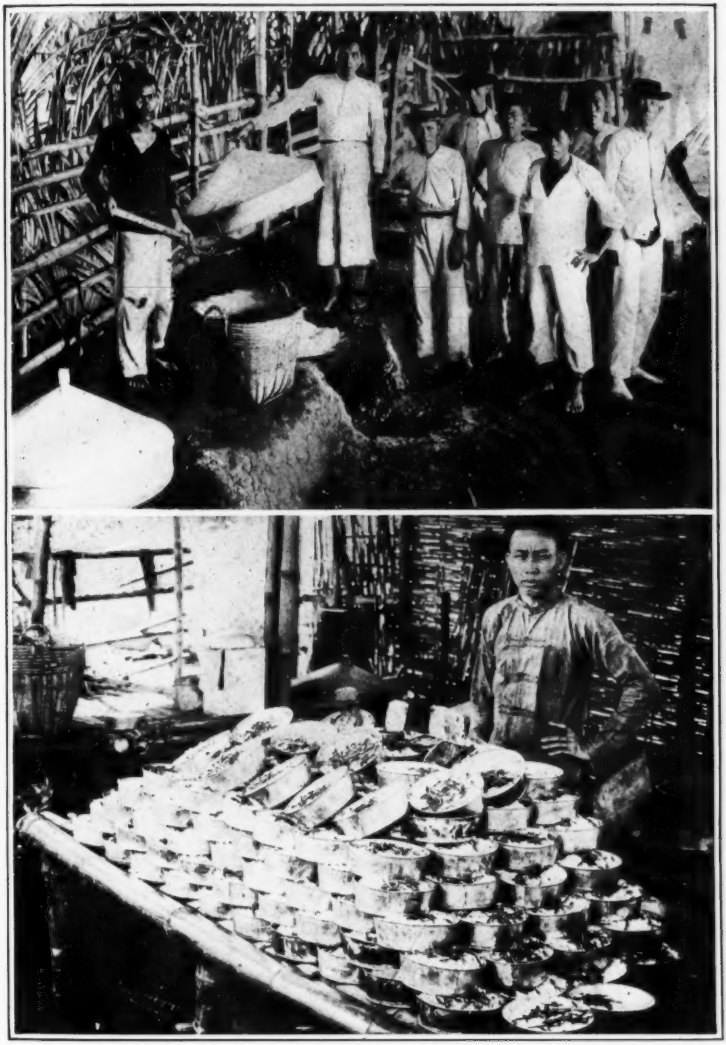
observe with fervor all the holidays in the original Roman Catholic calendar, which subtracts quite a liberal proportion of the total available time of each individual. At the same time the organization as a whole has suffered no demoralization nor has progress been in any material degree impeded. Testimony of this is afforded by the cost of grading, which—taking Cebu for an example because it represents organization in the more advanced stage—is but 12½ cents per yard, being practically, 25 per cent rock work. Steam shovels and the other auxiliaries for heavy grading, as a matter of policy, have been given no place yet in the construction equipment. Heavy transportation expense (which must be reckoned both ways), and cheap labor, have left the pick, the hand shovel, and the wheelbarrow sole possessors of a field in which to prove themselves, and they seem to be doing it, in native hands, never more effectively.

MOVING EARTH FROM A CUT WITH WHEELBARROWS, PANAY DIVISION.

At first a strong predilection appeared for the use of feet and hands rather than picks and shovels for working earth, and it was difficult to persuade some that the wheelbarrows were not receptacles to be carried upon the backs or heads, according to the ancient custom of burden bearing throughout the Orient. With the use of just a reasonable amount of tact and patience such as should be possessed by all white men in colonizing work, and which is nearly always possessed by the colonizing Britisher, for instance, the foregoing little idiosyncrasies of the Filipino were quickly overcome.

ABOVE, CHECKING MEN AT END OF DAY'S WORK. BELOW, PAY DAY AT HEADQUARTERS. BOTH ON THE ISLAND OF CEBU.

A part of the good result achieved by this American construction company in the use of native labor on engineering work, which contrasts with the lack of success met with formerly by Spanish com-



COOK HOUSE OF AH GONG, THE COMMISSARY AT ILOILO. FOOD READY FOR DISTRIBUTION TO NATIVE WORKERS.

panies, may safely be ascribed to one radical change in the mode of management. Formerly it was the custom to hire labor by contract. The contractor or *haciendero* habitually reduced the wages to as low a

A CUT AND A FILL, WITH NATIVE LABORERS AT WORK.

FINISHED GRADE JUST NORTH OF JARO, PANAY DIVISION.

scale as was possible and still keep the men somewhere near the job. Worse than this, they not infrequently withheld wages altogether. Under the new *régime* the *haciendero* is eliminated and the real employer deals directly and pays wages directly. As soon as the men realized that steady work meant steady pay and a regular dependable cash income, they took hold hard.

The chief engineer has little but praise for the qualities of the natives as railroad builders. Already, he says, many have attained an efficiency almost, if not quite, equal to that of white laborers, working, not in the Philippines or other tropical lands, but at home in the United States. This substantiates what was learned in the construction of the Manila Street Railway—that when properly handled, the natives can be safely relied upon to acquit themselves creditably of their part in laying a stable foundation for their own industrial and commercial welfare. While it cannot reasonably be claimed that they are fit to govern themselves now, the natives when given a perfectly fair show have not failed to demonstrate their capacity for work, and their aptitude, and it is really left only for the Government to encourage and support such industries as will give them their full opportunity. The sole essentials for a pronounced material welfare, aside from governmental stability, are sufficient natural resources and this industrious spirit, so there is no basic reason why the Philippines cannot be made a source of substantial national revenue to the United

THE CEBU TERMINAL, EARLY IN 1907.

States. The construction of the Philippine Railways under Government patronage seems to be a long step in the right direction. A supplementary and not less essential one will be the provision of a market in the United States for Philippine products.

All of the hundreds of thousands of dollars distributed as wages will be spent and circulated in the Islands. An industrial army of from 20,000 to 30,000 men will have been formed, and such of these as are not required in the operation of the railroads will be available for other industries which will surely be given a strong impetus by the supply of good and cheap transportation. All who have been engaged on the railroads will have for themselves an unprecedented and invaluable training in the habit of regular work. Some will go to the mechanical trades and industries where their special training will stand them in good stead, and some will go back to the plantations where their increased efficiency will find full scope in helping to develop the output scientifically so they may meet the increased demand for their products that will come with cheap and effective transportation. All these economic effects redounding to the future prosperity of the railroads are attained practically without sacrifice in the present construction work. Allowing the possible maximum difference in wages between the two classes of labor, labor as a whole is so cheap that the total cost of the roads could not have been varied more than 5 per cent by the use of Chinese.

# THE COMPARATIVE COST OF STEAM AND HYDRO-ELECTRIC POWER.

*By William O. Webber.*

**The extent to which Mr. von Schon's recently concluded discussion has been quoted or reviewed, shows that in his comparison of steam and hydro-electric power an important subject was ably handled. We are glad in the subjoined pages to follow the topic further under the guidance of another specialist whose cost data are drawn from actual experience with working installations. It is a mistake to assume, as one or two of our correspondents have done, that there is a shadow of unfriendliness to the steam-power plant, or of over-partiality to the water-power, in the mind of either of our contributors or of the Magazine. The engine can never be dispossessed by the water wheel, under the utmost conceivable extension of the development of stream powers. But in the interest of economy of natural resources it must be supplemented as far and as fast as possible, and Mr. Webber unites with Mr. von Schon in displaying the comparative economy at which this new and additional power resource may be secured, using the more familiar type of installation as a standard.—THE EDITORS.**

THE articles by Mr. H. von Schon which appeared in THE ENGINEERING MAGAZINE, April-June, 1907, appear to me after careful reading to be the best written on the subject for some time. In the main they command full agreement, especially as to the concluding installments. In the cost comparisons given in the initial section of the argument, however, there is opportunity for discussion and I submit the following data by way of commentary and supplement.

As usual in similar cases, no account has been taken of the land upon which all power plants must be situated (unless on board ship or attached to flying machines), and while the cost of buildings is generally placed too low, nothing at all is allowed for the construction of proper chimneys.

Take, for instance, the 10 horse-power plant, where the cost of buildings is given as $400. This would just about build the chimney for such a plant, and the boiler and engine room would cost at least as much more; while, in the items for boiler and engine, no account seems to have been taken of the auxiliaries, which, in most urban districts at least, are compulsory in connection therewith.

If, for the sake of argument, it is assumed that so small a plant as one of 10 horse power would be a semi-portable plant, with a simple sheet-iron chimney, then the extra fuel costs would much more than make up for the fixed charges of a return-tubular boiler, with proper brick setting and brick chimney.

I have found that, with coal at $4 a ton, the cost of steam power per brake horse power is almost exactly double the cost of the fuel alone. The accompanying table, based on actual experience, shows that, with fuel at $2.50, the rates per horse-power hour are as follows:

| | | | | | |
|---|---|---|---|---|---|
| 4.65 | cents | for | 10 | horse | power |
| 3.42 | " | " | 20 | " | " |
| 3.76 | " | " | 40 | " | " |
| 2.41 | " | " | 60 | " | " |
| 2.20 | " | " | 80 | " | " |

With coal at $4.50 a ton, these rates would be

| | | | | | |
|---|---|---|---|---|---|
| 6.+ | cents | for | 10 | horse | power |
| 4.50 | " | " | 20 | " | " |
| 3.66 | " | " | 40 | " | " |
| 3.20 | " | " | 60 | " | " |
| 2.92 | " | " | 80 | " | " |

I append on the opposite page two tables of actual installations, showing what costs actually are, also just below on this page, a table of the value of small powers, from 10 to 80 horse power, and on page 892 is a diagram which, I believe, more nearly represents actual practice today; I have prepared also, and give on page 893, a memorandum of working plants which have come under my own personal knowledge, with the actual results as obtained.

COST OF ONE STEAM HORSE POWER, PER BRAKE HORSE POWER PER YEAR.

| Size of Plant. | 10 | 20 | 40 | 60 | 80 |
|---|---|---|---|---|---|
| Cost of Plant per Horse Power.. | $230.00 | $200.00 | $190.00 | $180.00 | $175.00 |
| Fixed Charges at 14 Per Cent.... | 32.20 | 28.00 | 26.60 | 25.20 | 24.50 |
| Coal per Horse Power per Hour.. | 15.00 | 12.00 | 10.00 | 9.00 | 8.00 |
| Cost of Coal @ $4.00 per Ton.... | 82.50 | 66.00 | 55.00 | 49.50 | 44.00 |
| Attendance 3,080 Hours..... | 50.00 | 30.00 | 20.00 | 15.00 | 13.00 |
| Oil, Waste and Supplies per Year. | 10.00 | 6.00 | 4.00 | 3.00 | 2.60 |
| Total ..... | 174.70 | 130.00 | 105.60 | 92.70 | 84.10 |
| Without Coal ..... | 92.20 | 64.00 | 50.60 | 43.20 | 40.10 |
| Coal @ $5.00 per Ton..... | 195.00 | 146.50 | 119.35 | 105.07 | 95.10 |
| " " 4.50 " " ..... | 185.01 | 138.25 | 112.47 | 98.80 | 89.60 |
| " " 4.00 " " ..... | 174.70 | 130.00 | 105.60 | 92.70 | 84.10 |
| " " 3.50 " " ..... | 164.38 | 121.75 | 98.72 | 86.51 | 78.60 |
| " " 3.00 " " ..... | 154.00 | 113.50 | 91.85 | 80.32 | 73.10 |
| " " 2.50 " " ..... | 143.74 | 105.25 | 84.97 | 74.13 | 67.60 |
| " " 2.00 " " ..... | 133.42 | 97.00 | 78.10 | 67.95 | 62.10 |

There is no question as to the cheapness of hydraulic power; I have many figures, ranging all the way from $3.38 to $6.00 per horse power per annum. The actual costs on hydro-electric power vary, of course, with the distance the current is transmitted; but they may be taken, approximately, as $10.16, in the immediate vicinity of the water-fall, $11.66, with a four-mile transmission, and $12.81 for a 20-mile transmission.

TOTAL COST OF INSTALLATION, 10 HORSE-POWER STEAM PLANT.

| | | |
|---|---|---|
| Land for Engine and Boiler Room, 300 sq. ft. @ $1 | $300.00 | |
| Boiler and Engine-Room Building, 300 sq. ft. @ $1.50 | 450.00 | |
| Chimney, 18 in. by 40 ft. | 400.00 | $1,150.00 |
| 10 H.P. Boiler | $241.00 | |
| Boiler Foundation and Setting, 3,900 C. B., 500 F. B. | 160.00 | |
| Blow-Off Tank | 31.00 | |
| Damper and Regulator | 75.00 | |
| Injector Tank | 10.00 | |
| Water Meter | 40.00 | |
| Piping for Same | 20.00 | |
| Pump and Vacuum | 122.00 | |
| Feed-Water Heater | 40.00 | |
| Pipe Covering | 50.00 | 789.00 |
| Engine, 7 by 10 | $184.00 | |
| Foundation for Same | 60.00 | |
| Steam Separator | 35.00 | |
| Oil Separator | 25.00 | |
| Piping | 95.00 | |
| Freight and Cartage | 30.00 | 429.00 |
| | | $2,368.00 |

Hydro-pneumatic power would be the only serious competitor for hydro-electric power within a 20-mile radius of a power plant; beyond that distance the electricity would always win. For very small plants, undoubtedly gasoline and the small producer-gas plant

TOTAL COST OF INSTALLATION, 60 HORSE-POWER STEAM PLANT.

| | | |
|---|---|---|
| Land for Engine and Boiler Room | | $2,500.00 |
| Buildings for Engine and Boiler Room | | 2,500.00 |
| Chimney | | 1,200.00 |
| 80 H.P. Boiler | $790.00 | |
| Ash Pan for Boiler (Below High-Tide Level) | 120.00 | |
| Boiler and Engine Settings | 1,282.00 | |
| Blow-Off Tank | 31.00 | |
| Damper Regulator | 75.00 | |
| Injector Tank | 10.00 | |
| Water Meter | 60.00 | |
| Piping for Same | 22.13 | |
| Pump and Receiver | 146.50 | |
| Feed-Water Heater | 70.40 | |
| Pipe Covering | 70.75 | 2,677.78 |
| Engine, 12 x 30 | $1,065.00 | |
| Pan for Engine Fly Wheel | 72.00 | |
| Steam Separator | 60.00 | |
| Oil Separator | 41.80 | |
| Piping, Freight and Cartage | 1,026.41 | 2,265.21 |
| Shafting in Place | $550.00 | |
| Belting in Place | 285.00 | 835.00 |
| | $199.55 | $11,977.99 |

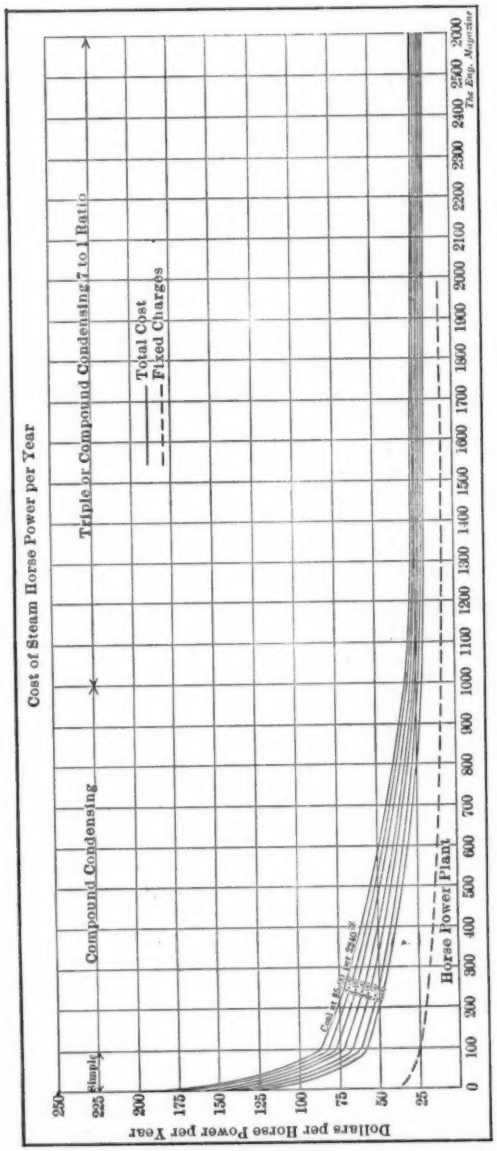



CHART SHOWING COST OF STEAM PER HORSE POWER PER YEAR UNDER VARIOUS CONDITIONS.

would successfully compete with electricity, as it would not pay to develop water powers so small.

Too much cannot be said in regard to proper development of hydro-electric plants. Even a period of 10 or 15 years is too short in which to study the monthly and annual precipitation on a given drainage area, as records show that marked variations, covering periods of 30 and 40 years, occur in the rainfall. The table on the opposite page shows the average of the flow of New England streams, and the figures will be seen to corroborate the dictum that one cubic foot per second per square mile is the maximum safe development of a New England stream.

TABLE OF AVERAGE FLOW OF NEW ENGLAND STREAMS.

| Months by Per Cent. of Collection. | Month and Number of Days. | | Average Rainfall, 1818-1897. | Average Per Cent. of Collection. | Depth in Inches of Collection. | Equivalent Run-Off in Cu. Ft. Sec. per Sq. Mile. | |
|---|---|---|---|---|---|---|---|
| 1 | Aug. | 31 | 4.35 | 21.3 | .9265 | .835 | |
| 2 | July | 31 | 3.68 | 21.8 | .8022 | .695 | |
| 3 | Sept. | 30 | 3.52 | 28.3 | .996 | .895 | .808 average flow for three dryest months. |
| 4 | Oct. | 31 | 3.90 | 29.3 | 1.143 | .99 | |
| 5 | Nov. | 30 | 4.30 | 36.5 | 1.569 | 1.41 | .965 average flow for five dryest months. |
| 6 | June | 30 | 3.22 | 44.8 | 1.442 | 1.29 | 1.019 average flow for six dryest months. |
| 7 | Dec. | 31 | 3.89 | 60.7 | 2.371 | 2.06 | |
| 8 | May | 31 | 3.80 | 65.8 | 2.50 | 2.17 | |
| 9 | Jan. | 31 | 3.95 | 76.3 | 3.014 | 2.61 | |
| 10 | March | 31 | 4.30 | 78.8 | 3.388 | 2.94 | |
| 11 | Feb. | 28 | 3.80 | 132.2 | 5.024 | 4.82 | |
| 12 | April | 30 | 3.98 | 145.0 | 5.77 | 5.18 | 2.16 average flow per year. |

I do not agree with Mr. von Schon that hydro-electric developments should be "based on some stage between the low and normal flow," as it has always been found profitable to carry on the development to some stage between the normal and high flow of a water shed. This can be determined only upon local costs of auxiliary power, but usually can be taken up to the average flow of the ninth month, in the order of dryness.

TABLE OF ACTUAL COSTS OF WORKING STEAM PLANTS.

| Ave. H.P. | Cost of Coal per Ton 2,240 Lb. | Total Cost per Annum. | Remarks. |
|---|---|---|---|
| 182 | $3.50 | $57.59 | No land or building cost. |
| 133 | 3.25 | 60.00 | " " cost. |
| 100 | 3.50 | 65.60 | " " or building cost. |
| 97 | 4.45 | 86.80 | All costs included. |
| 75 | 2.90 | 92.40 | No land or building cost. |
| 50 | 4.75 | 111.05 | " " " " " |
| 20 | 4.45 | 133.50 | All costs included. |

# A GRAPHICAL WALL RECORD FOR THE PRODUCTION DEPARTMENT.

*By H. L. Whittemore.*

**The graphical record and the card index are well-known aids to effective works management. Mr. Carpenter, in his widely noticed current series in this Magazine, has pointed out the stimulating influence exerted by publicity in the records of work expected and work performed in various departments. The system explained below by Mr. Whittemore is an ingenious and admirable combination of all these elements into a plan interesting in its originality, and offering many possibilities of advantage in its introduction into the factory.—THE EDITORS.**

ANY "recording system" may be considered a machine for memorizing facts which preserves the original entry, unaltered, for any length of time. The human memory, on the other hand, not only has a very limited capacity, but the record is gradually obliterated until finally it ceases to exist. Apparently these machines are as successful, in replacing the unaided human faculties, as the other machines which are considered so important in modern production methods. Certainly they have come into very general use, especially for commercial purposes. Even when the magnitude of the task does not make them a necessity, they often reduce the cost of the work, as they may be operated by persons unable to perform the duties without their aid.

Other advantages are that they may be used by any number of persons, either for the purpose of recording or for obtaining information, and they continue to serve the interests of the organization creating them, independent of changes in personnel.

Without some means of crystallizing the ideas or facts into tangible form, no record would be possible. There are many ways of accomplishing this, among which may be mentioned the phonograph and the telegraphone, but visual records are the kind most generally used. In some cases, it is possible to record ideas by photographs or drawings of the objects as they appear to the eye, but not all ideas can be so expressed. Written language (which is said to be a highly developed outgrowth of the pictorial records of our primitive ancestors) has, however, universal application. While the majority of our records will continue to be made in written English with the necessary labor reduced to a minimum by the use of abbreviations, printed

forms and columns properly headed, some special cases allow other means to be employed to advantage. Of these, shorthand is a good example.

Diagrams, where they are suitable, possess the advantages that they are easily read and quickly constructed. Possibly they could be more often used for record purposes, if their advantages were duly considered. The diagram employed for this production record, upon trial, proved to have the unexpected advantage that the facts were presented much more quickly and clearly than by the customary written record. It was devised for one of the departments, known as Division C, of a manufacturing plant employing several thousand men. From it is gained quickly, accurate information regarding the progress of the work upon any order received by the division.

All drawings and specifications, for the use of the shop, are prepared by the engineering offices, of which Division C is one, from the orders received from the sales department. Changes made necessary after an order is issued are made upon a "change notice" form similar to the printed form used for the orders, and distributed in the same manner to the engineering offices. While information relating to any order may be given verbally by one department to another, it is unofficial unless contained in a letter to the department for whom it is intended.

The route followed by an order, in Division C, is shown in Figure 1, divided into three distinct parts—the work of the engineers in determining upon the design, that of the draftsmen in preparing the drawings (if new ones are necessary) and compiling a list of the ones to be used (in either case), and finally, the preparation of the specifications by the specification clerks.

The production record follows a parallel route at the desk of the production clerk. He devotes most of his time to this work and only under exceptional circumstances allows a record to leave his possession. For the record, the card form shown in Figure 2 is used. This is filled out from the order when the latter is first received from the sales department, then filed, conspicuously, in the wall rack (L-O, Figure 1) until the work of Division C is complete. Upon the completion of any part of the work, the order is returned to the production desk to allow the record to be posted, when the position of the record in the wall rack is also changed.

The most unusual feature of the record card is the calendar along the top edge upon both sides. The part containing the current month is always visible when the card is filed in the wall rack (see

Figure 6) and the diagram upon it supplies all the information usually required. By arranging the calendar, thus, in four lines, the scale is made large enough to allow the dates upon the diagram to be accurately read. The lines which should represent Sundays are omitted as it is found that by so doing, the diagrams are more quickly drawn and also that time intervals, in weeks, are quickly estimated. Of course, this makes a new calendar necessary for each year. Orders which extend from one year into the next are continued upon a new card and all such cards are fastened together by paper clips. If desired, the diagram may be continued upon the first part of the calendar on the same card, even though it is incorrect, provided the diagram does not overlap. This avoids the use of more than one card for an order except in rare instances. Probably some form of perpetual calendar could be devised for this pur-

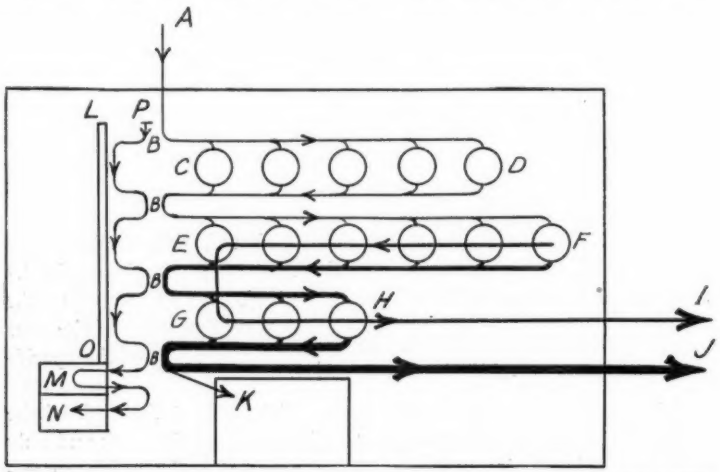
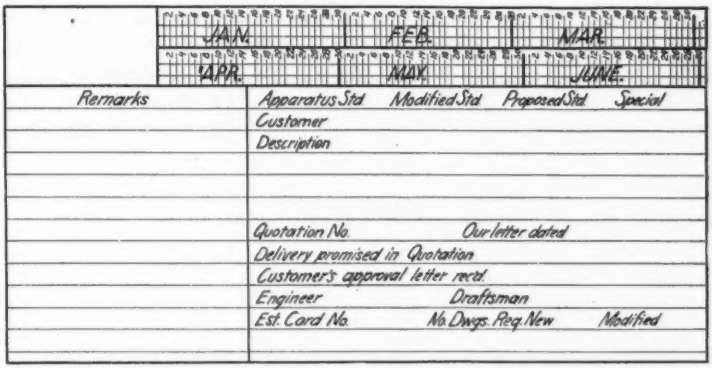



FIG. I. DIAGRAM SHOWING THE ROUTE A-J, OF ORDERS; PARALLELED BY THE ROUTE P-N, OF THE PRODUCTION RECORD.

The orders are received at the production desk, B, from the sales department, A; distributed to the engineers, C-D, who return them to the production desk, B. They are redistributed to the draftsmen, E-F, who return them with a list of the drawings required. The drawings pass directly to the specification clerks, G-H, then to the shop blue-print stores by way of the blue-print department, I. The orders are received by the specification clerks, G-H, from B, and returned with the complete specifications. Copies of the order, drawing list, etc., are filed in the vault, K, for office reference and the specifications delivered to the shop, J. The production-record card is filled out at P, when the order is first recieved at the production desk, B. It is then filed in the wall rack, L-O, constantly changing its position as the work upon the order progresses. When the completed specifications are sent to the shop, the record is filed in the "shop file," M, until notice is received of the final shipment of the apparatus to the customer, when the record is transferred to the "completed file," N.



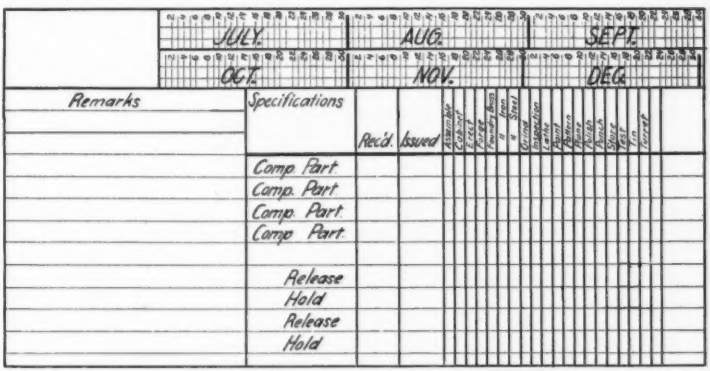




FIG. 2. THE FORM USED FOR THE RECORD CARD, 4 BY 8 INCHES.

A complete history of every order is recorded upon this card, most of it graphically upon the calendar at the top which is always visible when the card is in the wall rack. Besides requiring somewhat less time to make, the graphical record has the great advantage that from it a grasp of the situation can be gained which would be almost impossible from a written record.

pose which would be satisfactory, even though it did not possess all the advantages of Figure 2.

The time required for the engineers and draftsmen to complete their work is recorded by the length of the diagram drawn by the production clerk upon the first of the horizontal lines through the calendar. While the engineer supervises the work upon the drawings, it is comparatively seldom that he causes serious delay upon them when once started. Moreover, as no definite division can be made between the work of the engineer and that of the draftsman, a large

dot is used to record the date at which the drawings are started, so that an estimate may be made of the time required by each of them. The middle horizontal line is used for the record of the specification clerks and the heavy bottom line for that of the shop, although the work of Division C is complete when the diagram reaches the shop line.

The appearance of this record at various stages of completion is

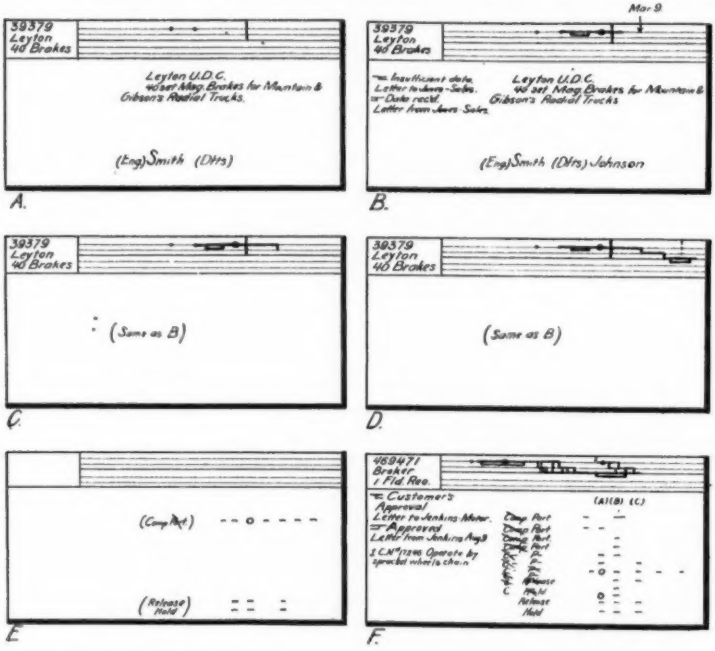



FIG. 3. PROGRESSIVE STAGES IN THE COMPLETION OF A PRODUCTION RECORD, SHOWING GRAPHICALLY THE PROGRESS OF THE WORK UPON THE ORDER.

A. Card as filled out upon receipt of the order; first dot—date order was issued; second dot—date order was received in Division C; vertical line—shipping date specified.

B. Large dot—date drawings were started; double line—"hold" upon the order.

C. Drop in diagram to second line—date specification clerk received the order and the list of drawings.

D. Drop in diagram to the bottom line—date specifications were delivered to the shop; double line—"hold" upon work in the shop; dotted vertical line—date of shipment promised by the shop.

E. Reverse of D. Dashes—the departments in the shop to which specifications were delivered, or notices to "hold" or to "release hold" upon the order. Complete, not partial, specifications sent in this case. Circles—departments assembling the completed apparatus.

F. Example of record such as occurs frequently in practice. Second part of diagram (1)—"change notice" altering the method of operating the apparatus.

shown in outline in Figure 3, only the written portion of the card being shown and the printed calendar being omitted so that the record lines may stand out more clearly on the small-scale reproduction. At the left of the calendar is placed a very concise copy of the order for which every suitable abbreviation is used. Beneath the calendar, this is repeated more fully but still in condensed form due to lack of space and the cost of making a full copy.

A shows the appearance of the record at the time the order is delivered to the engineer; B, upon March 9, after the drawings have been started as indicated by the heavy dot. As the production clerk extends the diagram after having made personal inquiries of the person having the order in his possession, the interval between the end of the diagram and March 9, shows that he has not "looked up" the order during that time. Usually such intervals should not exceed six days, at most. While the production clerk is not given authority to dictate to any member of the staff regarding an order, but only to gather and record the facts, his inquiries and suggestions tactfully made are a material aid in completing work rapidly.

A "hold," indicated by the double line, records the length of time work upon the order was delayed due to circumstances over which Division C had no control—in other words, a delay for which Division C is not responsible. The reason for the "hold" is stated under "remarks," in this case (B) the lack of necessary data to proceed with the design. The engineer, upon discovering this fact, stated the circumstances, including the fact that the order was held, in a letter to Mr. Jones of the sales department. Such letters being brought to the attention of the production clerk, he recorded the "hold" beginning upon the day the letter was written. Upon a request that the work upon an order be discontinued, coming from another department who assume the responsibility for the delay, a "hold" is recorded in the same manner, but in any case correspondence must be available for any "hold," clearly showing the inability of Division C to proceed with the work. The "holds" are released in much the same way by correspondence. In the case shown in B, the hold is released by a letter from Mr. Jones supplying the data.

Shop "holds," as illustrated in D, differ from those in Division C, in that they may be placed upon an order either by persons within or without that division. They are recorded upon the diagram in the same manner and a record made, as shown at E, of the departments notified of both the "hold" and of its "release."

The record is completed by the production clerk when he is ad-

vised of the date on which final shipment upon an order is made to the customer. He then draws a short vertical line across the shop line, and usually a diagonal line across the card from corner to corner upon both sides to prevent its ever being confused with current records. From the time the diagram reaches the shop line until shipment is made no attempt is made to post the diagram unless a "hold" is placed upon the shop or a promised shipping date is obtained from them. Usually the shop portion of the diagram is drawn entirely at the time the record is completed. The information to be obtained from this production record, as illustrated in Figure 3, is, then, somewhat as follows,

A, the order was issued February 2, and received in Division C, February 10, about one week later. Shipment is to be made February 28. Mr. Smith is the engineer having the order in charge.

B, (March 9) the engineer was unable to proceed with the work so the order was "held" in accordance with this letter to Mr. Jones of the sales department written upon February 13. Mr. Jones' reply, supplying the data, was received upon February 20, the day it was written, and the "hold" was removed. This caused a delay of one week. Drawings were started by Johnson, February 24. The shipping date has been passed and the order was last "looked up," by the production clerk, upon March 3.

C, the drawings were completed upon March 10.

D, complete specifications were delivered to the shop upon March 17, Saturday, and they promise shipment upon March 24. Work was, however, "held" in three departments of the shop, from March 19 to March 27. Division C is then responsible for 28 of the 43 days between the time the order was issued and the time specifications reached the shop.

E, the record of the departments to which specifications were sent is a check upon complaints from the shop, that no specifications were received or that "release" notices were not sent to all departments receiving "hold" notices.

While only a simple case is illustrated by the cards, A to E, much more complex ones are similarly made, as shown by F, which is by no means an example of extreme complication. From this it will be seen that specifications were sent to the shop upon seven different days and all except the last were partial specifications only. Later the method of operating the mechanism was altered by a "change notice." Work was immediately "held" in the shop in departments, A, B, and C, until the necessary changes in the specifications could

be made. "Rush orders" frequently make it necessary to send specifications to the shop as rapidly as they are completed, so that frequently complicated records result.

It is desirable to print the calendar portion of the card in red or other light color so that the diagram, drawn in pencil for convenience, will show well by contrast. While it was intended that all the blanks shown in Figure 2, should be filled out by the production clerk in the course of his work, it is very seldom, in the everyday rush, that more appears upon the cards than is shown in Figure 3. The reason

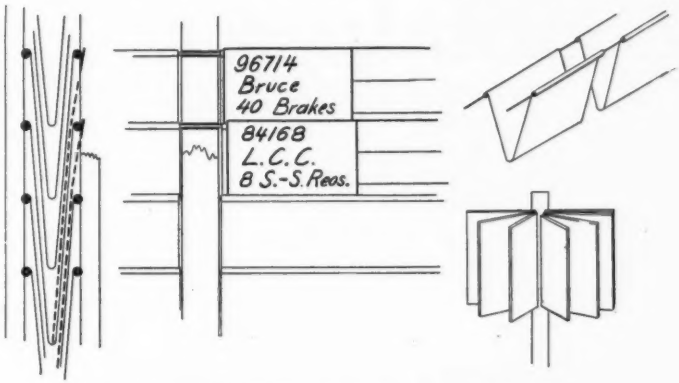



FIG. 4. SWINGING WALL RACKS FOR CURRENT ORDERS.

Both sides of the swinging panels are used for filing record cards, their size and number depending upon the number of cards. The cards are held in pockets formed of sheet metal and suspended upon wires. As they are without joints it is impossible for the cards to slip down inside the rack. The frames may be of wood or metal. This arrangement, while much more compact than that shown in Fig. 5, secures but little more publicity for the records than an ordinary card file.

for this is that the information which we must have to complete the card can only be obtained from the engineer after the latter has given the order some consideration, which it is not always convenient for him to do immediately. While it might be obtained by properly planning the whole order system, use seems to show that it would hardly be worth the increased cost, and that the best results are obtained by requiring of the production clerk only such work as requires no technical knowledge. As he is the only person recording information upon the cards, he alone is responsible for its accuracy, as well as for the constant use of the information at his command in assisting the remainder of the staff to complete the orders rapidly and accurately. He is in a position to prevent many costly errors,

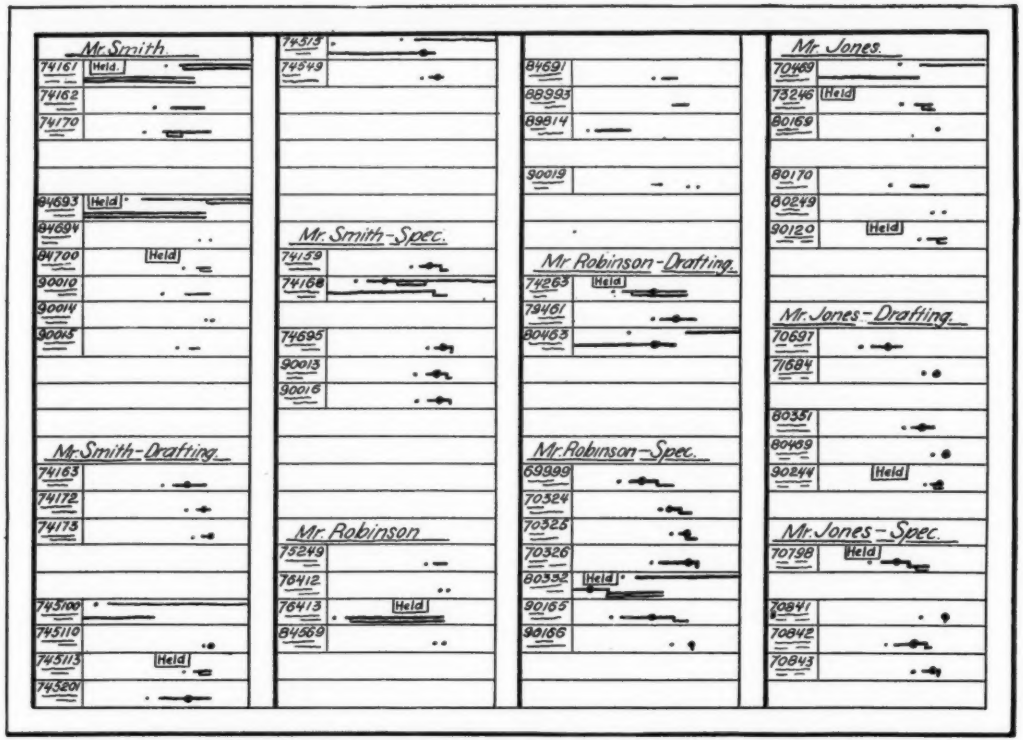



FIG. 6. STATIONARY WALL RACK (L, O, FIG. 1), SHOWING ARRANGEMENT OF RECORD CARDS FOR CURRENT ORDERS.

The orders for which each engineer is responsible are grouped together for convenience. This allows him to follow their progress without making personal inquiries. Any other arrangement could be used. They are subdivided into those in his possession personally and those upon which the draftsmen and specification clerks are at work. Of the cards illustrated in Fig. 3, A should be filed under "Mr. Smith"; B, under "Mr. Smith—Drafting"; and C, under "Mr. Smith—Spec." The division headings, (Mr. Smith—Drafting) are lettered upon cards which can be easily shifted as circumstances require. The record cards are filed numerically in any one division. By glancing down the columns the orders which have been making unsatisfactory progress may be rapidly selected.

such as the delivery to the shop of specifications upon an order which is "held."

The wall racks which may be used are detailed in Figures 4 and 5. The latter is the form used in Division C, and it presents the appearance shown in Figure 6. Empty pockets, at frequent intervals, permit new cards to be inserted quickly in their proper numerical order.

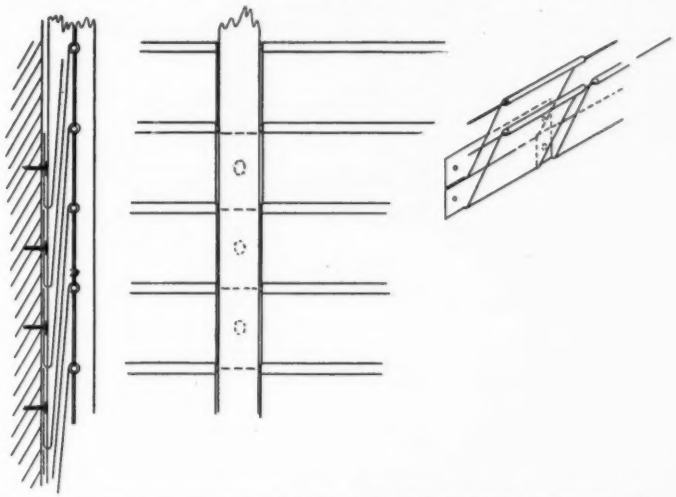


FIG. 5. DETAIL OF STATIONARY WALL RACK FOR CURRENT ORDERS, FIG. 6.

Sheet-metal pockets for the cards. The rack used in Division C measures about 6 ft. by 8 ft. and contains between 600 and 700 pockets. To prevent loss of time in shifting cards, about twice the number of pockets absolutely necessary should be provided.

Each record card is filed first under the name of the engineer, say Mr. Smith, then under his drafting and specification sections, although the men doing the last two parts of the work are not confined to his work at all but take orders coming from any of the engineers. The position of the card, then, in the rack, always corresponds with the member of the staff having possession of the order. Those upon which "holds" are placed are tagged with removable clips such as are used for indexing ledgers and other work. They are removed with the "hold" as seen in Figure 6. When removed from the wall rack, upon the completion of the specifications, the card is removed to a card file as shown at the top of the case in Figure 7. It is filed there numerically and tagged "held" if such is the case. Upon completion of the order in the shop the card is transferred from this "shop" to the "completed" file contained in the drawers shown in

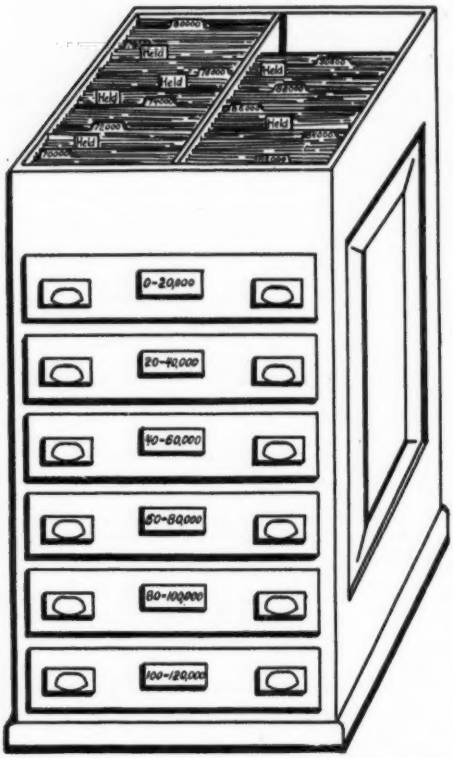



FIG. 7. FILING CASE FOR THE "SHOP" AND THE "COMPLETED" FILES.

The open card file at the top of the case or "shop file" (M, Fig. 1) has a capacity of about 4,000 cards and is used for all orders for which the specifications are complete but the shop work incomplete. Of the cards illustrated in Fig. 3, D, E and F should be filed in the "shop file." The drawers in this case form the "complete file" (N, Fig. 1) for all orders upon which final shipment has been made. The record cards in both of these are filed numerically.

Figure 7, where it is also filed numerically.

The staff of Division C consists of about 60 persons and the number of orders usually in the wall rack is 200 to 400, while the number of orders received each month varies from 300 to 400. The production clerk whose desk is directly in front of the wall rack is able to answer inquiries relating to orders very quickly. It is nothing unusual for the number of these to reach 75 per day, and many persons, after the first few times, consult the records themselves, especially if the production clerk is occupied. If necessary, they consult the key to the diagram posted, for their convenience, at the side of the wall rack.

This record was intended to economize the time of engineers and draftsmen by keeping for them, in the shortest form possible, an accurate record of the work assigned to each which would prevent their overlooking any order, and also to prevent interruption of their work by questions which could be cared for more efficiently by a central information bureau. It not only performed these requirements satisfactorily but also proves to have a noticeable effect upon the staff due to the publicity secured for the

records. Persons having a number of orders which they have found difficulty in completing rapidly were much more concerned over that fact after the record cards were filed in the wall rack than they were before. Without any additional pressure from the executive it actually reduced the number of current orders in the department, permanently.

Accurate information, instantly available, at times proves very effective, as for example when a person from another department, who is very angry because an order is "held," is informed that the "hold" was placed upon the order in accordance with his instructions contained in letter of May 19, that the customer's approval must be secured before the work is carried further. While this record not only proves to be an assistance in preventing delays within the division, it is equally valuable in reducing the friction between departments as it allows the responsibility for delays to be definitely fixed.

Some record of this kind is almost the only possible way for the executive to gain, daily, a definite idea of the work in the department. Ten minutes, in this case, is sufficient for him to select those orders which are not progressing satisfactorily and to which he wishes to give his personal attention. Perhaps for that very reason the wall rack is found to have a most surprising effect in keeping the work "cleared up."

# THE DESIGN AND CONSTRUCTION OF INDUSTRIAL BUILDINGS.

*By D. C. Newman Collins.*

THE establishment of a new industrial enterprise, or the extension of one already operating, is fundamentally a matter of investment, depending upon its future earning power, its initial cost and the cost of maintenance. Success depends upon an intelligent analysis of a multitude of details in advance of actual purchase and construction, the governing considerations being efficiency, low cost, and permanence. Blunders are easily made, they are expensive to correct and frequently impose a perpetual tax upon the future profits of the enterprise.

This is a progressive age in which the competitive procession is gaining speed with every step. It is not a matter of choice that we keep pace with it; we have to, or be trodden under foot. An industrial manager is confronted with the rigid condition of his selling prices being limited by his competitors', but he does not find the same limitation in his operating expenses. In fact, as time goes on he finds market prices lowering and the cost of production increasing. Labor demands are becoming more arbitrary and indefinite, more expensive and less subject to control, and yet labor is the factor controlling the quantity, quality, and cost of his factory output. Probably the most expensive and important item in manufacturing lies right here; manufacturing may be done by machines, material may be produced chemically, supplies may be handled mechanically, power devices may be used in carrying, transporting, and shipping product, but in every system, whether ancient or modern, the commanding factors are the brains and brawn of the operatives. Not only is the cost of production dependent upon the proficiency of the human equipment, but the grade of product, on which depends the standing of the firm in the commercial world, is dependent upon the quality of labor employed.

The general recognition of this fact is shown by the vast amounts of money expended for machines and devices for saving labor. Fortunes are invested simply to cut down the number, and increase the capacity, of the men. A comparative glance at an old and a modern

shop will show the latter to be characterized by the absence of men and the substitution of ponderous machines. In many cases one man can now do an amount of work impossible for twenty without this mechanical aid, and he can do it faster and better. It requires $25,000 invested at four per cent to maintain one man in service at $1,000 per annum; if his output capacity should be hampered by discontent, poor air or light, miserable sanitary conveniences or gloomy environment, it is equivalent to a corresponding loss in working capital. On the other hand, if the same man is in good physical trim and mental condition and is contented, he can do better work and more of it. If a machine or mechanical device can be introduced to double this man's output, it is not a difficult problem to compute how much can be spent on it as a good investment.

It seems only fair to assume that a close study of labor is fully as important to the success of any enterprise as an investigation of the mechanical possibilities. An incapable, negligent or inefficient workman is not only a loss in the wages paid him but he holds up machine energy as well. A machine is a willing tool if installed and used with judgment, skill, and care. Poor alignment, improper adjustment, and dry bearings are traceable directly to an inattentive workman who has neglected this important element of efficiency. This inattention may be caused by discontent or mental hostility toward the management, due to the indifference of the manager to the needs and requirements of the workman.

To insure the best results the entire system must be harmonious and co-operative. The mechanical equipment has an output limited by the diligence and skill of the human equipment and both are subject to the supreme judgment and co-operation of the management. Harmony, co-operation, and system are the essence of industrial success; and in laying out industrial improvements, the manager accountable for the proper expenditure of vast sums of money has a responsibility upon his shoulders that warrants the expenditure of a small amount in obtaining skilled backing and advice, to promote an intelligent and thorough consideration of all these points and to check extravagance and error. The presentation of an enterprise in such clear shape as to bring up all points for discussion is, in itself, sufficient ground for payment of an expert fee. One idea incorporated in the work at the right time may have an earning power greater than the entire fee charged.

The laying out of an industrial plant cannot be governed by set rules, except that it is always best to know, before launching the pro-

ject, exactly what you are going to do, to make sure that it is right, and to know positively what it will cost and what it will earn. Every industry has its individual peculiarities to be met and the tedious discussion necessary to a proficient analysis of all points takes time and careful study. In starting a layout we are confronted with an indefinite mass of details, one dependent upon the other and all of such importance and yet of such an indeterminate character that progress, even by a skilled specialist, can be attained only by careful comparative studies combined with a knowledge of prevailing prices, market conditions, and the suitability of various materials for the purpose.

Industrial buildings should be designed to form a single unit when combined with the equipment; should be developed together with the mechanical layout and criticised by a rehearsal of methods of operation at different periods of development. The buildings can attain their maximum degree of efficiency only when they have been designed for the work in view, and do not come under the classification of "Architecture" as it is generally understood. Ornamentation does not earn money; embellishments are useless; frills are superfluous, and all are an unwarranted expense. The relief given in the treatment of these buildings, on the outside, should be limited to such requirements of the structure as tend to give it strength, firmness, permanence, and an appearance that will evince comfort and common sense. The inside, however, is much more important as an earning factor.

### Preliminary Work.

The difficulty of making the first step is well met by an approximate block plan incorporating the natural resources of the locality and a rough tentative scheme of operation. This report should be comprehensive and accurate, although approximate. It should cover, in a general way, the entire proposition, embodying a skilful presentation of the whole matter that will dispose of many indefinite details and simplify the decision of others by concentrated discussion.

This preliminary report should necessarily be accurate as regards estimated costs. The personal interest of an engineer should never affect his reliability, and he should quote prices that he can back up, and give estimates that will not invite too small an appropriation. Too often is an owner influenced into beginning an enterprise with insufficient funds to complete it, and when too far involved to withdraw is compelled to provide more money and ruin his investment. The selection of an engineer is entirely a matter of confidence in his integrity, loyalty, and skill.

In laying out new plants it is very essential to begin on a plant of much greater size than is required for present purposes, in view of future extensions. Too often is an owner compelled to abandon a plant and build entirely new because of the impossibility of accomplishing good results by erecting around existing buildings. A large plant layout may be started and only such parts of it actually built as are required for immediate occupancy, leaving connections and details ready for adding extensions without the unnecessary expense of tearing out and patching. The remodeling of an old plant to avoid interruption to existing crowded conditions is a special study, presenting a great field for resource and genius.

The preliminary report should be based upon an actual layout of the different departments, using approximate areas in order to shuffle them around until the best operating sequence is obtained. The method is tedious but the results form the best possible grounds upon which to begin work. Upon this layout fairly accurate estimates of the cost of the buildings can be made, and machines may be located; a mental rehearsal and discussion of the operating system is promoted from which improvements are recorded. To make it complete the report should give the close cost of buildings of the most suitable dimensions, details, and type of construction to fulfil the requirements and should also supply the discussion with approximate costs of other types of construction and styles of buildings so as to simplify rather than control the manager's efforts, and to promote a quick and decisive settlement of the essential points to be considered. The manager is then fully equipped to measure his investment, gauge his appropriations, and decide when and how to proceed to the successful accomplishment of the enterprise. He has a brief layout upon which to base criticism and invite suggestions. The opinions of his staff can be recorded and the probability of mistakes greatly lessened, before he has begun to spend money and while still in a position to withdraw if he finds the cost of the enterprise too high to be profitable.

A thorough preliminary study of an industrial project cannot be taken up too early. It costs no more to do it at one time than another. Such studies frequently prove of great value in checking and verifying the suitability of a new site for the purpose before purchase, and in illustrating the application of the geographical conditions and natural resources of a property to the particular requirements of the case. Every manager has a rough idea of his needs and should never lose control of the details of their accomplishment, but he rarely feels secure until his ideas are expressible to others for the criticism and discussion which are the best possible means of locating faults.

The limitations of this article will not permit of an exhaustive treatment of the mechanical and general equipment of an industrial project but will confine it to the commercial achievements of economic construction of the buildings, and the ethics of contracting.

### Type of Building.

The type of the buildings is usually fixed by their suitability in simplifying the method of production as well as the convenient and rapid handling of material during the various processes of manufacture. Where heavy material is handled it is generally desirable to keep it near the ground in one-story buildings, and a careful study of the loads to be transported will show whether the desired results can be obtained by good timber construction or will necessitate the use of the more expensive concrete or steel. The material of construction will be affected also by the accepted method of handling material. A thorough analysis of transportation methods is a very important item, and an intelligent start on the buildings is impossible until this has been made. Where the material is light and the operating process will permit, a building of two or more stories may be selected, thus effecting an economy in lot area as well as a general saving in power transmission, heat, etc. The principal value of preliminary work concentrates right here, in measuring the efficiency and cost of the various labor-saving devices and in combining them with their contingent effect on the cost of buildings. The selling price of a device may show it to be a good investment but its effect upon the cost in building may make it look different. The consideration of these items should be finished before the buildings are developed on definite lines.

The next consideration is the industrial sequence of operation and the approximate area required for each department, from the receipt of raw material to the shipping of finished product, the idea being to have the general current of operation flow in one direction and to avoid the return of any material toward the place of beginning. A study of these features permits of a determination of the loads imposed upon the building and a much more intelligent consideration of ventilation, light, heat, and the location of sanitary conveniences. It also affords a basis for the proper consideration of fire hazard. The elimination of fire risk not only effects an economy in insurance premiums but it also reduces the possibility of an interrupted business. Insurance may cover a fire loss of plant and material but rarely provides for the loss in future business or the damage due to broken promises and the impossibility of filling orders.

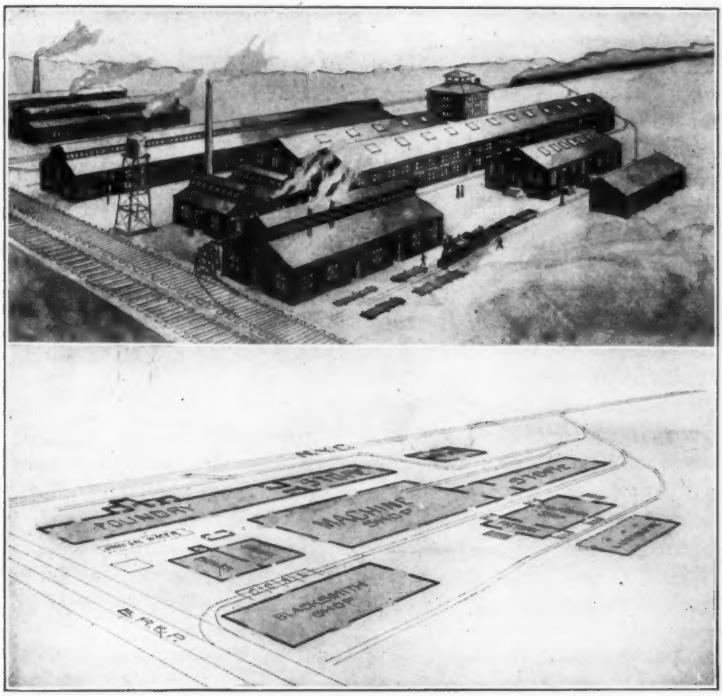



FIG. I. PRELIMINARY SKETCH NO. I. A LIGHT SHOP ARRANGEMENT.

When the weight of material handled is too heavy to be transported by truck, trolley, elevator or conveyor, it generally demands the introduction of overhead electric traveling cranes, and unless other considerations predominate will recommend one-story buildings, but it does not necessarily imply that all buildings should be one story. In many instances one, two, or more galleries have been enclosed under the same roof with the cranes, for the convenient location of the lighter machines adjoining the crane-covered floor area. Certain departments may be under separate roofs and the building may be made several stories high if proper arrangements can be made for transferring material from one to the other.

The question of grouping many departments under one roof is one that affects the layout, first cost, and fire hazard. Where the product is non-inflammable, and the operations permit it, many departments may be grouped under a single roof without dividing walls, and great

savings in the initial outlay may be effected without any great increase in the risk, providing the buildings are reasonably fireproof. When the stock is of an inflammable character or the buildings, by requirements, are not necessarily fireproof it is better to separate the departments by fire walls and under separate roofs and the smaller the floor area in each department the less the liability to general conflagration.

Preliminary sketch No. 1 shows a plant for manufacturing a light product where considerable quantities of wood are assembled in the machine shop together with iron parts. No cranes are required except in the foundry and in the center span of the machine shop; a brief description will illustrate why the buildings were grouped as shown and why the cost of additional brick walls is warranted, rather than a more general grouping under one roof.

This foundry does mostly duplicate work from stock patterns, which fact permits of its separation from the carpenter shop and pattern shop, and the protection from gases from the foundry, together with the fire risk of combining it with the above mentioned shops, were deemed sufficient to recommend its separation from the other buildings. The blacksmith shop is separated for the same reason and is brought nearer the carpenter shop for the reason that the smith work is largely applied to wood and the shops should be in direct touch.

The machine shop has a gallery for light machines around the assembling floor, which is covered by crane; the machine store is equipped with a similar gallery, and the paint shop, between, has two floors. It can be readily understood why this building should be separated from the others. The power house and pumps are combined under one roof and are separated from the other buildings.

Preliminary sketch No. 2 shows a rough layout for the manufacture of valves. The office, pattern shop, pattern storage, and the power house are separate as a matter of fire protection, to effect the general separation of labor, and for the comfort and convenience of workmen. The departments in the main building are separated by fire walls and automatic fire doors for fire protection, and the operation of the plant causes a natural flow toward the shipping rooms without obstruction. The classification of labor in this layout is beautifully provided for as all material and work can be charged against one department until the product is turned over to another, when it can be credited in regular sequence and charged to a customer on shipment.

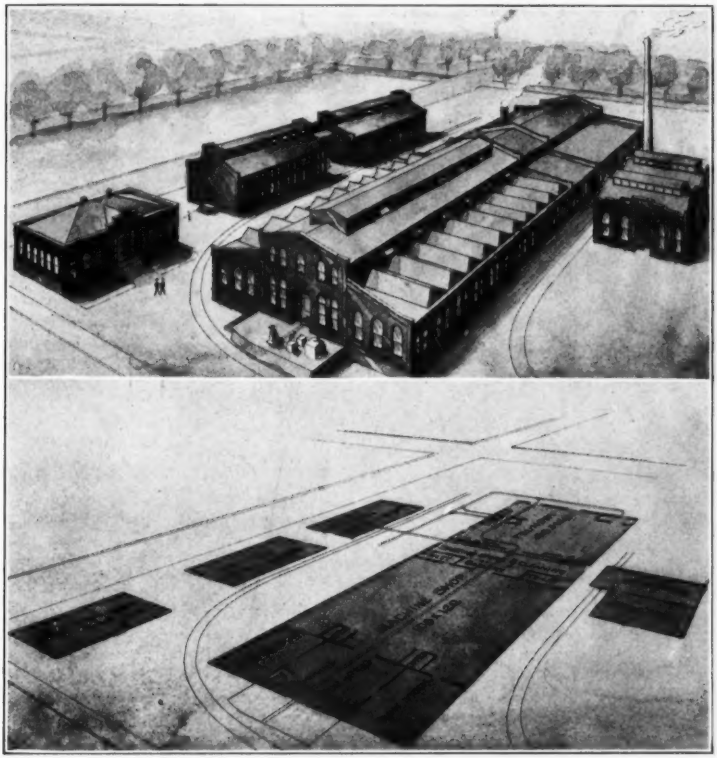


FIG. 2. PRELIMINARY SKETCH NO. 2. A SHOP FOR THE MANUFACTURE OF VALVES.

The machine shop, cleaning and storeroom and stockrooms, are built with galleries to economize space. The additional cost of separating these departments would be in an extra brick wall and foundations at the end of each, as well as in the transporting of all material a much longer distance, with additional cost of plumbing and heating due to the separation of the departments and the duplication of sanitary conveniences.

Preliminary sketch No. 3 shows another study of departments under one roof and yet isolated. The establishment is for manufacturing stationary engines and boilers. The foundry and power house are absolutely separate; the other departments are in direct touch with the erecting floor and yet can be separated where advisable to protect against fire. The sequence of operation here can be unob-

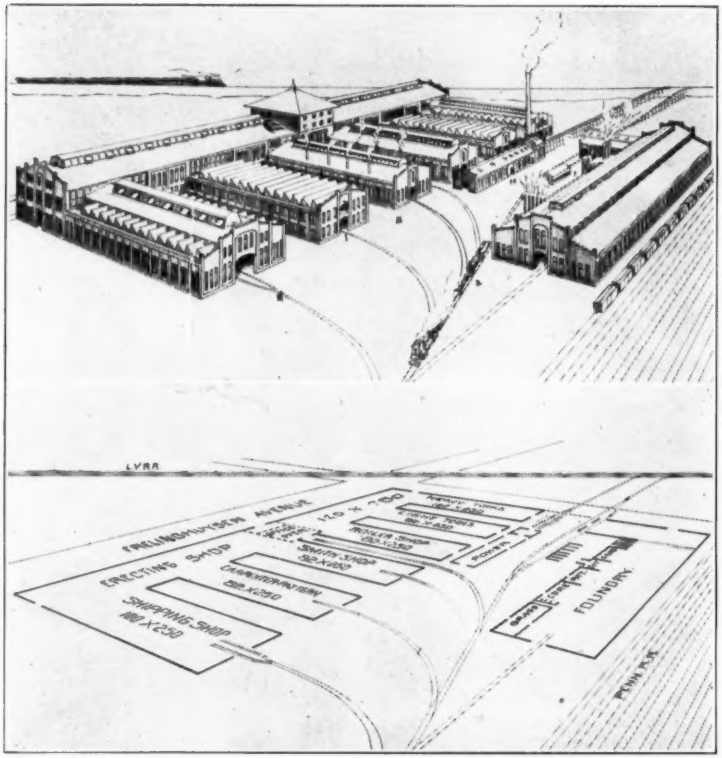



FIG. 3. PRELIMINARY SKETCH NO. 3. AN ENGINE AND BOILER WORKS.

structed and direct to the shipping room, each department contributing its share during the trip.

Passing to the other type, multi-story buildings, where the product can be handled readily by elevator, truck, or trolley, we have preliminary sketch No. 4, a spinning mill. The departments here are much larger and fewer in number and the departments are studied to suit more the dimensions of the machines than any special classification and separation of the work. It is permitted here to make a roof of each floor above, which effects a great economy in first cost. On account of the radical difference between the duties of the mill and dye-house, and the desirability of plenty of light and air in the latter, the two buildings were separated.

Preliminary sketch No. 5 shows another type of building with sev-

eral stories, for the manufacture of insulated wire cable. Upon investigation, it was found most economical to put all departments under one roof and to lessen the fire risk by a fire wall and automatic fire doors. Fire hazard in buildings such as Nos. 4 and 5 must be very carefully looked after, both in layout and in details of construction. It will be noticed in both of these buildings that all elevator shafts, stair towers, and other vertical flues connecting the various floors are separated from the main floors by fire walls and automatic fire doors. In buildings of an "L" shape like No. 5, all windows opening in the "L" are safe if made with wire glass and metal frames, or automatic fire shutters, to prevent the passage of fire from one wing to the other. No openings from one floor to another are allowed in the main building unless they are protected, all communication being made through

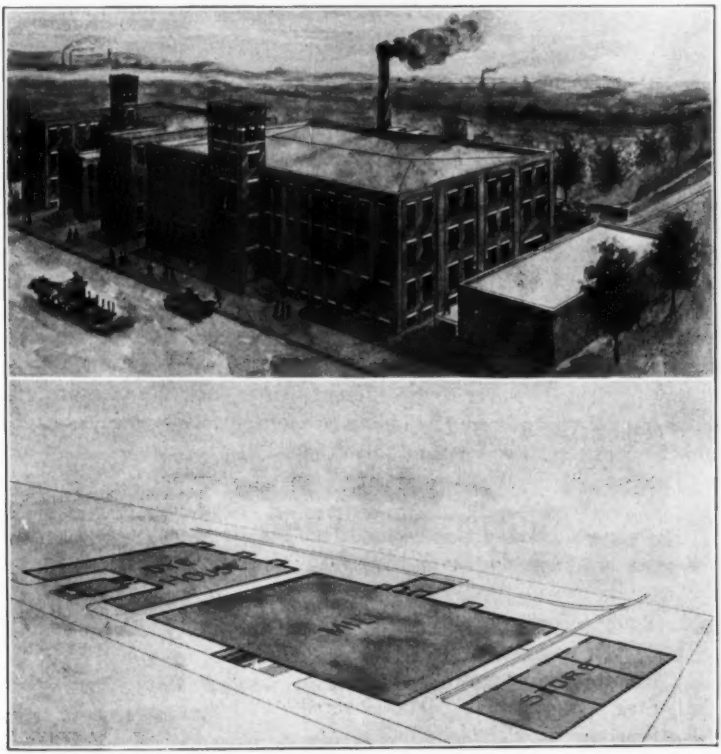



FIG. 4. PRELIMINARY SKETCH NO. 4. FOR A SPINNING MILL.

one of these fire towers. Automatic sprinklers prove a great safeguard in buildings of this class. They open up at the first appearance of excessive heat and sprinkle until turned off. To lessen the liability to fire damage, floors should be so built into the brickwork that in case of fire the falling of floors will not trip the walls and remove the protection to adjoining buildings. In many well constructed buildings, the floors have burned out completely leaving the walls standing in good shape for the support of new floors.

### Construction Material.

In deciding upon the best material to be used in the construction, a careful canvass should be made of local resources and prices of building materials, labor costs, speed in construction, and the limitations of local artisans in the diligent and proper execution of work. Rigidity, permanence and the cost of maintenance are important elements to be considered, and the ultimate decision should report recommendations for material most suitable from both a commercial and an industrial point of view.

The development of the buildings should be unprejudiced by any interest the engineer may have in any special brand of building material or in any contracting concern. He should be perfectly free to recommend the material best suited to the purpose and to direct the proper purchase unhampered by the claims of any interest outside that of his clients. Engineers are educated and trained to accomplish satisfactory results in the best manner and for the least money. Anyone can do great things with unlimited money and it does not require great skill to do cheap work. To decide exactly what is wanted and to buy it right, however, is a different matter, and the measure of results in dollars and cents will be in proportion to the technical skill and the commercial energy and talent applied to the work.

### Kind of Building.

The general construction of industrial buildings may be classified under six headings, each type having advantages and disadvantages, distinctly its own.

1, Timber Construction,
2, Timber and Brick,
3, Reinforced Concrete,
4, Steel Construction, Metal-Covered,
5, Steel and Brick,
6, Steel and Brick, with the Steel Wrapped or Fireproofed.

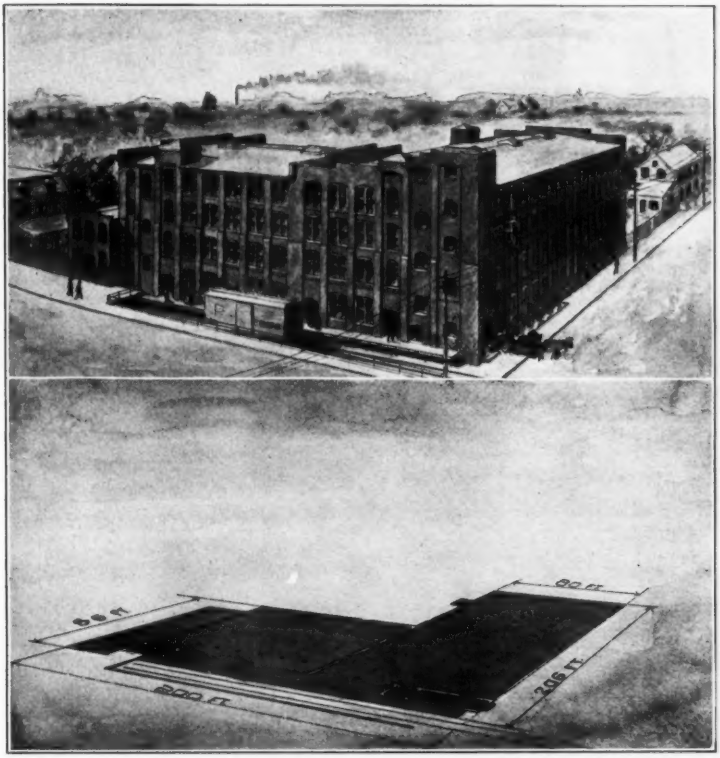



FIG. 5. PRELIMINARY SKETCH NO. 5. AN INSULATED WIRE CABLE PLANT.

The cost of the structures will run in about the order named, timber being the lowest and fireproofed steel the most expensive. There are of course, many combinations of the above mentioned materials that can be used, but for the purpose of this article these headings will serve.

Buildings built entirely of wood are usually adopted where permanence, rigidity, and fire hazard are of small importance. In permanent structures timber is used mostly on temporary work, because if used in a permanent structure the cost of maintenance would be very high and the building would be easily destroyed by fire and subject to early decay.

Timber and brick is much more satisfactory as the woodwork can be sheltered from the elements and preserved for many years if

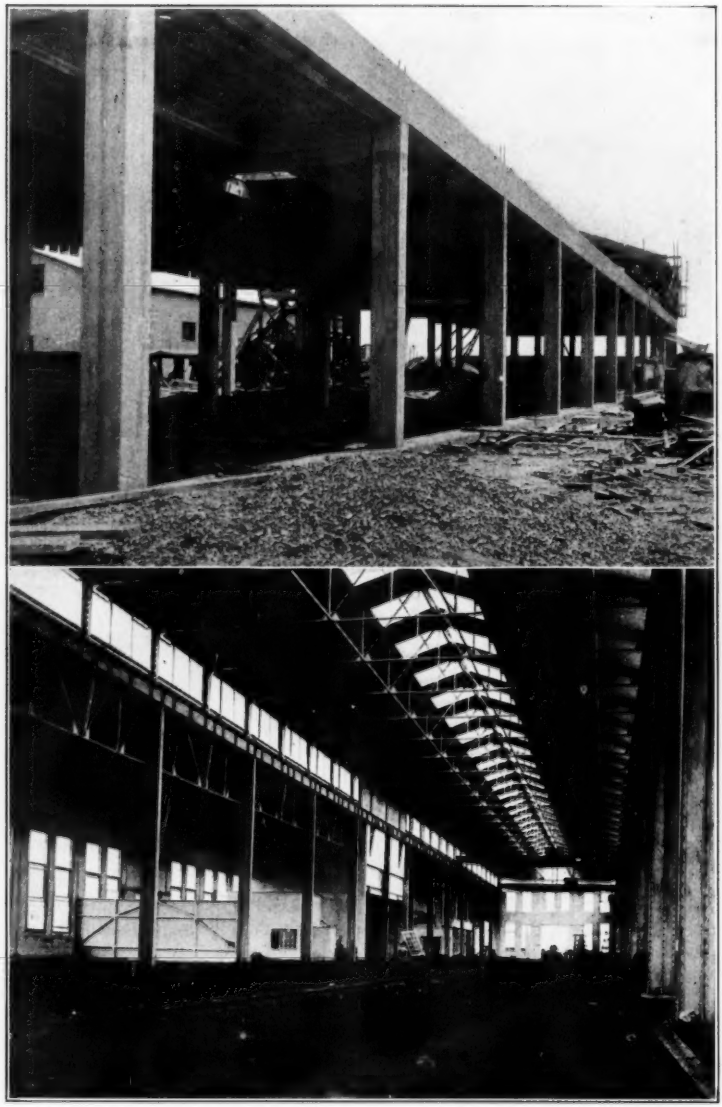


FIG. 6. FOUNDRY BUILDING OF STEEL AND BRICK, WITH CONCRETE AND PILE FOUNDATIONS AND SLAG ROOF.

The interior view shows traveling-crane service. The group contains also a two-story pattern-storage building, with reinforced-concrete walls filled with brick.

properly constructed. The low cost of this type of construction recommends it very extensively for buildings of several stories, and a well constructed "mill constructed" or "slow burning" building is eminently satisfactory for certain purposes. In its construction, however, there are many things to guard against, such as dry rot, dampness, distortion from shrinkage of timber, and the spread of flames before the sprinklers or fire apparatus can control them. The theory of insurance recommendations is not that the structures do not burn, but that they will burn with as little damage as possible and so that they can be rebuilt for a very small outlay.

FIG. 6A. EXTERIOR OF PLANT SHOWN IN FIGURE 6.

They are most convenient for the locating and anchoring of machines after completion of the building. The matter of excessive vibration, so troublesome to many owners, is due generally to faulty design rather than to insufficient material. I have had occasion to investigate the matter of vibration in some of the largest mills in the United States and Canada, and have found the cause invariably to be that the timber had a span too great for its depth or thickness. In regard to the strength of timber, a liberal factor of safety should be used on account of the indefinite character of the material. Timber is looked upon as the simplest kind of construction and it is fre-

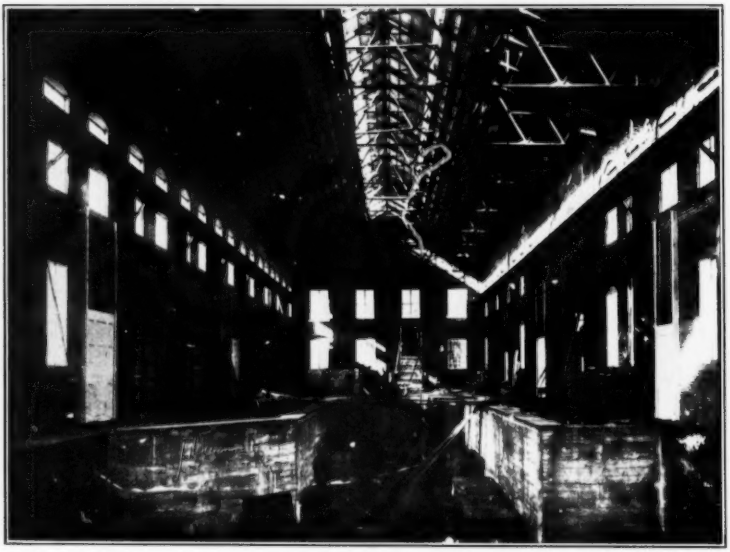


FIG. 7. PIPE FOUNDRY. STEEL FRAME, SLATE ROOF, BRICK WALLS AND FOUNDATIONS, CONCRETE CASTING-PIT WALLS.

Three traveling cranes on same runway, one for casters, one for moulders, and one for core makers.

quently put up from designs of a carpenter. In making extensions to old buildings that have been used for many years, an investigation of the loads placed upon the old floors has called attention to startling conditions of overloading of timber construction. I have failed to find any theory or practice that would prove their ability to withstand such excessive stresses, and have in some cases refused to duplicate the old design in the new work. Such perilous conditions may be due to faulty design, to imposing more severe duties than were ever intended, or to the fact that modern timber lacks the strength of old-time stuff. At any rate it is better for an engineer of reputation to stand criticism than to sponsor a design that may cause disaster. Timber and brick buildings when used with good judgment and handled properly are very pleasing, cheap and convenient and can be erected quickly in any location.

Reinforced concrete has fire-resisting qualities, permanence, and rigidity unequaled in any other type of construction. All designs for reinforced concrete are based upon the assumed strength of material to be manufactured at the site and upon the accurate location of

the reinforcement in the position shown on the drawings. For this reason it is important that the field details should be inspected carefully by the designer to insure a homogeneous execution of these essential features of the design. When such care is taken in steel structures to have all details fixed and checked by skilled engineers and also to have the work inspected in the mill and shops, the precedent established by long experience should be observed in reinforced concrete construction also. The beauties of concrete construction are best brought out by an administration incorporating good supervision, careful inspection, experienced management, and modern power equipment for executing the work. It should never be entrusted to amateurs.

The cost of reinforced-concrete structures is dependent upon local market conditions, labor proficiency and the required speed in construction. The building is first produced in wooden negative to mould the fluid mixtures to size and shape. The steel is then placed in proper position and the concrete poured in the moulds. The concrete is then allowed ample time to develop its strength before the removal of the forms in order to reset them for another pouring. A recent case where convenient shipments of material was possible

FIG. 7A. EXTERIOR OF FOUNDRY SHOWN IN FIGURE 7.

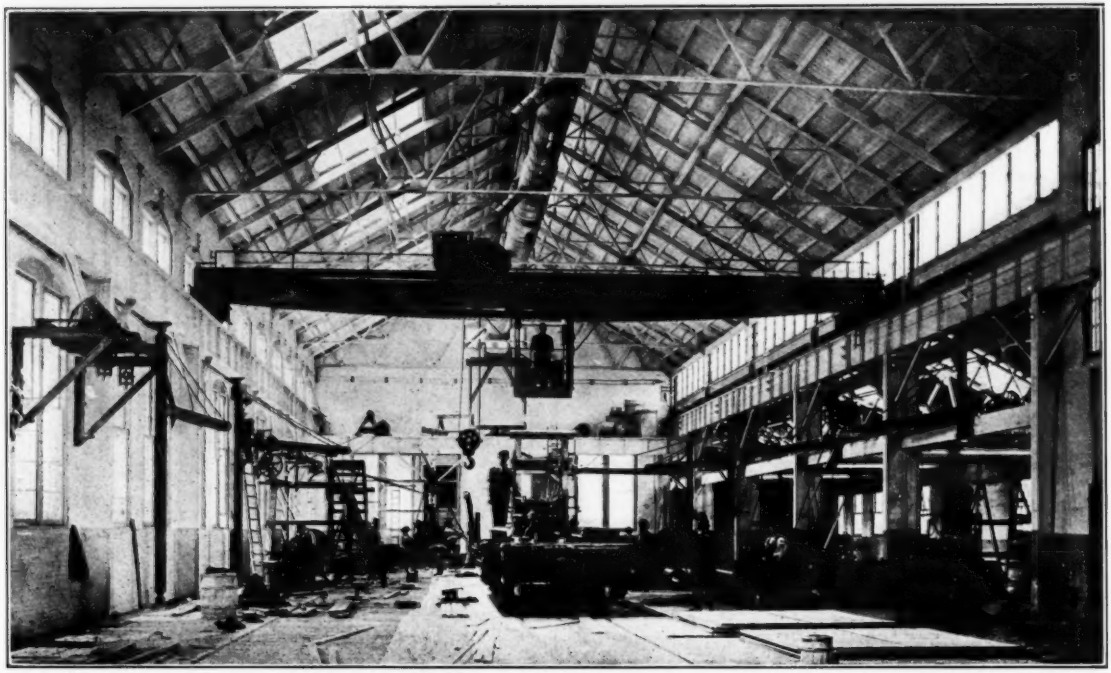


FIG. 8. HEAVY MACHINE SHOP. CONCRETE FOUNDATIONS, STEEL FRAME, BRICK WALLS, TAR CONCRETE FLOOR WITH MAPLE PLANKING TOP.

Note excellent lighting, and location of individual jib cranes for large tools. Driving motors are installed overhead, on platform, or in the roof of the lean-to.

by railroad direct to the building and where the time of completion permitted the resetting of the forms once illustrates the comparative cost of labor and material involved and the importance of good generalship in concrete construction. The cost of the material in the concrete alone amounted to 19 per cent., the cost of steel reinforcing delivered at the building 17 per cent., the total cost of labor 31 per cent., and of lumber for forms 33 per cent., of the total cost of the concrete frame of the building. From this it can be seen that nearly 2/3 of the entire cost of the work is in the items of lumber and labor alone. The costs of concrete material and steel are largely fixed by market rates and the cost of lumber for forms and of labor will be measured by the suitability of the design to the character of material used and by the judgment and diligence of the executive management.

As regards speed in construction, the cost will increase with the quantity of lumber used in the forms. The frequent resetting of forms will save lumber but requires more time. The nature of concrete is such that it requires time to develop its strength. Concrete in large masses dries slowly and its strength grows more slowly in cold than in hot weather. Its setting cannot be hurried beyond a certain point and an owner should temper any possible impatience by an appreciation of these facts. Concrete should be poured and finished in one operation without separate finishing of surfaces and when this is done it is practically indestructible by fire or acid. Its strength grows with age. Concrete is the best known agency for the protection of steel and it expands and contracts under the effects of temperature changes about the same as steel. Hence, there is no reason why any reinforced-concrete building, if properly constructed, should not withstand the ravages of time and tempest unharmed.

Steel construction is usually adopted where the requirements of the structure exceed the advisability of using timber or reinforced concrete. The fire hazard is small where the manufacturer's supplies are not inflammable and it is very safe from damage from adjoining fires. The metal covering of steel is generally a matter of very doubtful economy as it presents no stability to the structure and the bracing introduced in the steel frame to resist wind pressure, etc., on that account will add sufficient cost to it to put in a good wall. At best it is very perishable and liable to deterioration from the action of the elements or from gases and hard service.

Steel and brick construction for heavy structures comes in a monumental class for safety, reliability, and rigidity. It has no su-

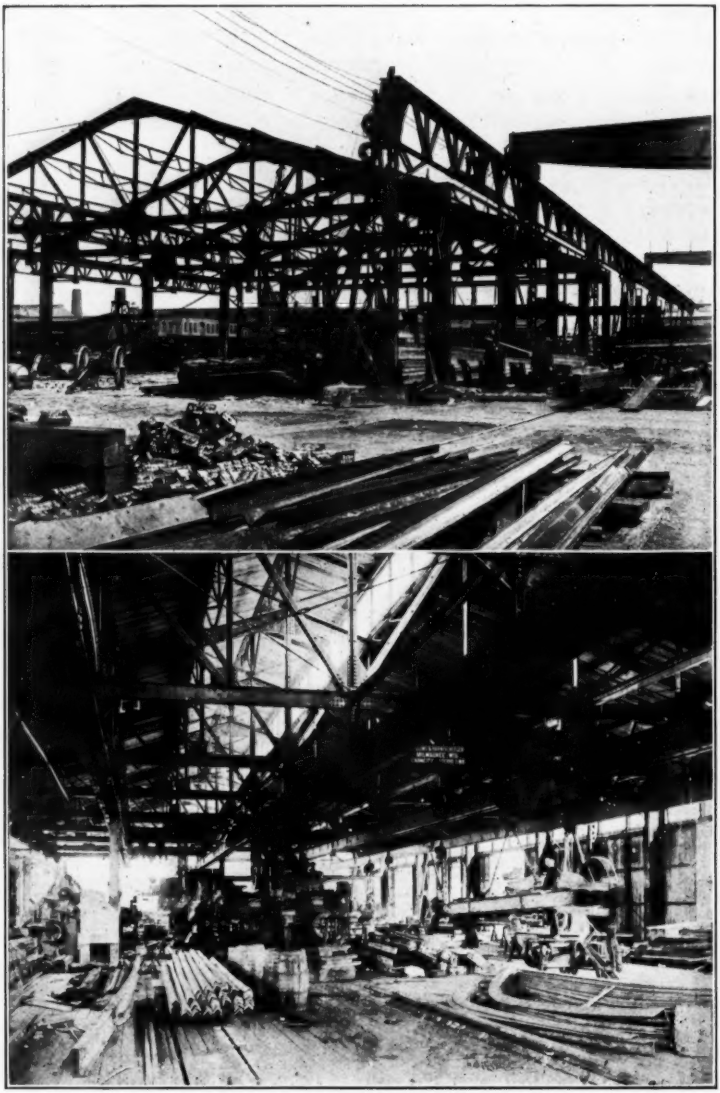


FIG. 9. STEEL SKELETON AND FINISHED INTERIOR OF BUILDING FOR MANUFACTURE OF STRUCTURAL STEEL.

The roof supports several short-span cranes, running longitudinally to feed machines, and the main posts carry also a yard crane for handling steel stock.

perior in permanence and strength and its stability can be impaired only by heat sufficient to melt it down or the action of the most destructive acids or gases. It can be made to do the most severe and extensive work safely, for its strength is a definite and known quantity. In steel construction the dimensions of every piece of material and the numbers and location of all rivets and bolts in the structure are calculated and checked by skilled engineers while making the designs and shop detail drawings. Nothing is left to the discretion of the field force except to assemble the pieces and fill the holes provided, with proper bolts and rivets. This eliminates any speculation as to the actual strength of the structure, particularly when the material is inspected during every process of manufacture.

In steel structures where the contents are inflammable or it is desired to guard against damages from a general conflagration, the steel is enclosed in fireproof materials as an extra safeguard and protection. When well done with proper material, this probably represents the best known type of heavy construction. With the exception of reinforced concrete, it has no equal in permanence and fireproof qualities and it can be relied upon to do the work required of it.

When combinations of the above mentioned construction materials are desirable, only an engineer having a thorough experience with them is well equipped to select the combination most suitable from every point of view.

### The Commercial View of It.

The material best suited to the purpose should be selected with just consideration of the requirements, together with recognition of the local resources and supply of material and the demands of local labor organizations. Every building project can be reduced to a matter of skilful purchase and proper delivery. Good purchasing organizations are equipped with a thorough knowledge of the market prices and conditions of delivery as well as the quality of material they have to buy. The foundation of good buying is broad and fair competition. There is only one way to get the full benefits of competition, and that is to establish exactly what you want to buy and how you want to have it delivered; tell the competitors all about it at the start, and let them all start on even ground and with no uncertainties to charge for. Whether the purchase is made in single items or *en masse*, this knowledge and record of details is indispensable to the intelligent handling of the work, and an engineer's office insufficiently equipped to direct the

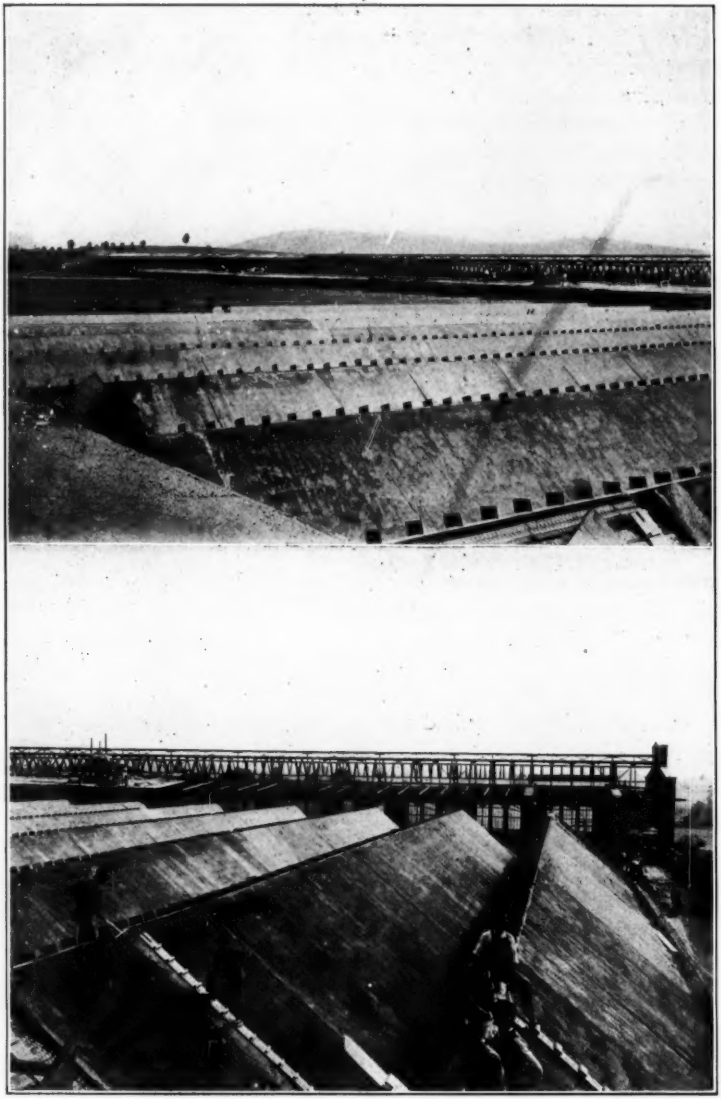


FIG. 10. SAW-TOOTH ROOF FOR BUILDINGS OF LARGE AREA.

The roof is of reinforced concrete, supported on steel and covered with slag. Entirely fireproof, and thoroughly satisfactory both as to service and as to illumination.

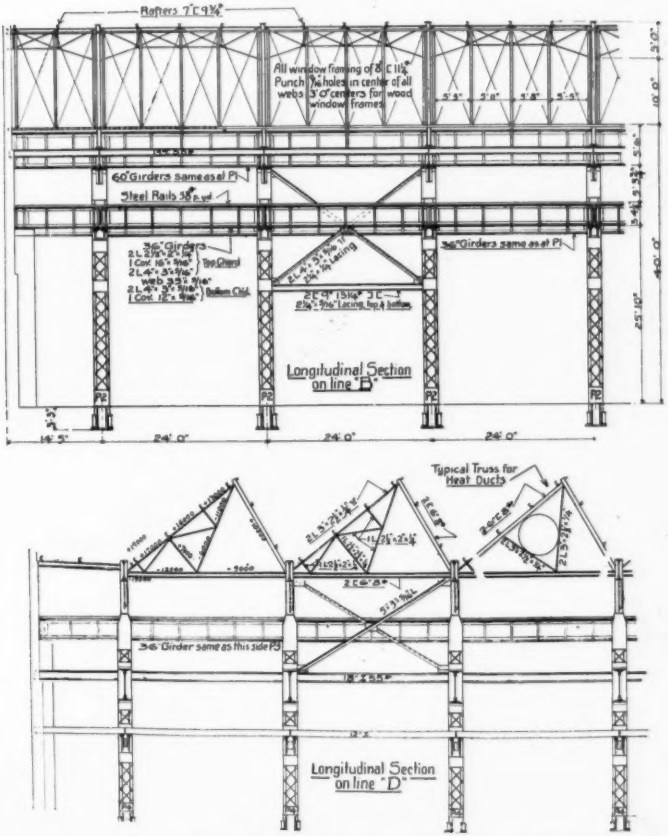

Rafters 7"C 9¾#
All window framing of 8" C 11½# Punch ¾" holes in center of all webs 3'-0" centers for wood window frames
60'Girders same as at P1
Steel Rails 56 #
36"Girders
36"Girders same as at P1
Longitudinal Section on line "B"
24'-0"
24'-0"
24'-0"
Typical Truss for Heat Ducts
36"Girder same as this side P3
Longitudinal Section on line "D"

FIG. 10A. SHOWING STEEL WORK OF BUILDING ILLUSTRATED IN FIGURE 10.

purchase campaign on his own work is certainly in a poor position to back up his preliminary estimates and to serve his client fully. When a preliminary report has been completed with proper consideration of the industrial, technical, commercial, and physical conditions attending the work, the manager is well equipped to say intelligently when to go ahead and prepare for the execution of the work.

The plans and specifications are simply an accurate detailed record of the material to be bought and delivered. They are used in canvassing the situation and determining the best means of handling the work, and serve as well as a legal claim for its proper delivery.

With the preliminary work completed and the criticisms on it recorded, the regular drawings are made to scale and a record of the smallest detail is expressed upon them. The more thoroughly this work is done, the closer together the competitive bids will run. All uncertainties in quantity and quality of workmanship and materials should be studied and settled at this stage so that bidders will all bid on the same thing and the work can be controlled by price alone. In this way bids can be compared intelligently.

### Method of Purchasing.

In buying building material there are countless methods and complications that are rarely duplicated. There are artists in every profession and trade, each offering what seems to be the most tempting proposal to get the work. It should be kept in mind always, that with complete plans, there is just so much material to be bought and just so much labor to be done, and the two together, under normal conditions, should cost just so much money. If an offer is made to do the work for very much less than it should cost, it should be looked on with suspicion. If a proposal comes in to execute it for a much larger amount, it should be put aside for a fairer method. Proposals are sometimes given in a single lump sum for the entire work, or they may be sent in as separate bids for each trade. Some will quote unit prices, so much per pound, per square foot, or per thousand, others will offer to do the work for a certain percentage of the cost, and may or may not give a limit of cost, and still others will agree to spend the money for a fixed fee and guarantee nothing, explaining that it is hard to beat cost prices. Some bidders boast that they will not estimate any work nor guarantee any costs, but will do the work for a fixed fee, penalizing that fee for any overrun above a fixed amount and taking a percentage of all savings made under that amount. Some bidders may propose to contract for labor only, all materials to be furnished by the owner—and so on in an unlimited variety, each one exploiting his own system as the only one to save the owner money. These various tenders do not affect the value of the work in the slightest, but it is a complicated matter to list them for intelligent comparison. In order to classify and assess each one for its true value, we come right back to the necessity of knowing all about the quantity, quality, and value of the material to be bought. The time of completion is another complication entering into the proposals. The higher bidders are sometimes the ones who make the best promises.

This is the period during which everybody is amiable and friendly, and makes all sorts of promises; it is also the time to nail down all loose corners. This campaign may show the lump sum to be the best, or it may show that the general contractors are all busy and the bids on separate trades show considerable economy. There are instances where changes are likely to be made during erection of the work and unit prices will permit unlimited changes without danger of excessive bills for extra work. There are times when a percentage form of contract will look good, or the fixed sum contract will have a special advantage. The success of the latter form of contract, however, depends largely upon the capabilities and diligence of the bidder in prosecuting the work economically. Unless he gives a guarantee there is no commercial inducement for him to put energy on it.

In cases where the early completion of the building is imperative it requires considerable ingenuity to assure it without paying a large premium. Very frequently the engineer prepares preliminary data from which competitive unit prices can be obtained and orders for material placed by the owner direct, without waiting for the plans to be finished in detail. In this way, material requiring considerable time to deliver can be ordered in advance and the plans be finished and other work prepared for its erection while it is in transit.

When steel contracts are placed direct at so much per pound, it is well to have the engineer prepare the detail drawings for the shop, in order to control the number of pounds. In lumber orders, the lists can be prepared by the engineer to control the number of board feet. When this is done the labor can be contracted for separately or by day work as conditions may recommend.

It should be borne in mind in splitting up contracts that there must always be a head to the administration of any contract to harmonize the varied interests, and a good superintendent acting under the engineer's instructions will fill the bill admirably. An engineer properly trained should be in a position to relieve the owner of all this worry and to protect his interests from beginning to end through any method that the owner's interests may suggest as being most economical. In this way, an engineer's fee becomes the best possible investment and cannot be looked upon as an expense.

It would require volumes of literature to cover a description of building details; they are unlimited in number and combination. In studying detail of an industrial building the principal consideration is always the execution of its functions as a manufacturing unit. Every inconvenience in detail acts continuously and effects a per-

petual loss in operation. On the other hand, every perfection in detail will assist the steady flow of profits. Next to this in importance is keeping down the amount of material to be bought and the consequent cost of buildings.

A few photographs of different types of buildings may serve to interest readers as they will show the combination of many details that were decided upon in various instances.

Many owners look upon industrial buildings as mere shells to give protection from the elements. They treat them as a single item without consideration of the multitude of details that combine to make success or failure. Frequently an owner will consider competitive figures on a building of a certain size as satisfying all demands of competition regardless of the uncertainty of what each bidder includes in his estimate and in absolute disregard of the helpless condition he will be placed in after the contractor is bound to deliver him a building and he is obligated to pay the contractor a sum of money.

The interest of an owner is not to get the cheapest building possible; it is to get the right kind of building as cheap as he can. When an owner puts himself in the hands of a contractor who is experienced in his business, without knowing and having a clear record of what he is to get for his money, he is adopting poor business tactics as the interests are entirely divergent in every way and the obligations generally flat. An invitation to bid in competition, if taken literally, means nothing less than a challenge to execute the work with as little material as possible and with the least amount of labor that the specified requirements legally demand. After the contract is signed, these legal records of requirements are the sole grounds for protection to the owner.

The ethics of contracting are broad and varied. Every contractor and material dealer has his own individual ideas of successful business policy, and they seldom permit a loss to himself. It is easy for an owner to award a contract, but sometimes much more difficult to satisfy himself that he is getting the value of his money. The awarding of a contract closes that end of it and if the requirements are indefinite so will be the results.

This is not intended to reflect upon the integrity or honesty of contractors or material dealers. The nature of a competitive inquiry is a strict challenge to beat the other fellow, and in doing it he is virtually complying with the essence of the inquiry.

# PROFIT MAKING IN SHOP AND FACTORY MANAGEMENT.

*By C. U. Carpenter.*

## VIII. STIMULATING PRODUCTION BY WAGE, STOCK, AND COST SYSTEMS.

Mr. Carpenter's series began in January, and the six articles heretofore presented discussed, first, the general methods of examining into the condition of any manufacturing business so as to discover the existence of waste and loss and to determine the "sticking points"; second, the nature and the working of the "committee system" of factory administration; third, the reorganization of the designing and drafting departments; fourth, the great importance and value of the tool-room as a source and spring of profitable methods; fifth, the general conditions necessary for manufacturing at minimum cost; sixth, methods for fixing standard times for manufacturing operations. Seventh, minimizing the time of assembling.—THE EDITORS.

IN the preceding articles of this series, methods of determining with accuracy the shortest possible time in which any job can be done were fully discussed. There I dealt with the latest tables showing the best possible cutting speeds on lathes, planers, and drill presses, and also described methods by which the shortest possible time on intricate assembling jobs can be determined. Naturally, the determination of this "shortest time"—this fixing of the "standard time"—will prove of great assistance in the collection of prime labor-cost data on any and all jobs of work.

Before giving consideration to systems of cost-keeping or to the stock-keeping and stock-tracing systems which are interlocked therewith, it is important that we briefly consider the question of the *wage* system under which the men must work, and which to them is the all important feature of their shop life.

We manufacturers must keep in mind just what actual shop life and the wage system mean to a workman. We, who have crawled up the scale, now look upon a broader horizon of opportunity. We are not surrounded by those inexorable conditions which to a large extent absolutely regulate the life of the average workman. We are not subject to the whim of a job boss or assistant foreman, who holds his place perchance through favoritism or relationship to someone in power, and who looks with frowning mien upon any improvement which might be suggested and for which he may not get the credit; whose control over five-twelfths of daily existence is well-nigh absolute; who can make the daily work easy or hard, the daily earnings

for the all important livelihood large or small, by apportioning the work unfairly. We are not compelled to work under a system of pay that provides no especial recompense for extra effort and extraordinary output, but which on the other hand often rewards (?) extra thought and extra skill and effort by a cut in the rate or "price," which leaves one working, perhaps, 20 per-cent harder than a few days before with a daily return in wages no larger than formerly—our job boss or foreman adding to the "pleasure of the incident" by proudly showing how he "cut that price 20 per cent, saved the company a large sum of money, and still 'gets the output.'"

Much has been written upon the subject of systems of pay and many broadsides have been fired at the old system of piece work, *coupled as it so often is with the practice of cutting rates when the men begin to earn large wages.* But it is far from being blown out of existence, for today the majority of factory managers still adhere to these methods. Understand me, I do not criticize the piece-work system *per se,* but I do strongly condemn, as unfair and uneconomical, the habit of cutting of rates when wages become high which almost invariably accompanies the system. In fact, I have found the same tendency to exist in the case of the premium and other systems of pay, in some cases. The mischief is very largely caused by the practice of setting "original prices" or "original times," not based upon data scientifically determined, but upon "best previous records," an ordinary "try out" or, worst of all, the "foreman's estimate." It is because of the importance of the system of pay and because of the inefficiency of the ordinary methods that I have tried, in the preceding paper, to lay down some principles or rules that may be a guide in securing proper results and in giving us a secure and accurate foundation upon which to build our structure of proper factory management.

We must ever keep in mind that recompense to the workman is only one part of our total cost. A largely increased production per square foot of floor area means lower cost through the decreased proportion of overhead or indirect cost per piece. Further, it means a much quicker movement of stock and thus a release of working capital through reduction of investment in stock. It means better satisfaction to selling department and customer through quicker deliveries, and almost invariably an increase in sales with a heavy decrease in cost of selling per article. The average factory manager will term this far-fetched; but any man who has reorganized a completely run-down concern, and built up the manufacturing, selling,

and financial ends of a business, knows that there is nothing so vitally important to the success of the business, in every direction, as the quickening of shop production and the possibility thus secured of making a quicker turn-over of working capital invested. The average factory manager gives little thought to this, but the financial officers and backers spend many worried hours trying to make both ends meet and wondering "where all the money goes."

### Problem of Introducing "Standard Time."

We may be sure that, having collected all of our data relative to standard times, we still have before us the problem how to introduce these—how to persuade the workmen to work to them, or in shop phraseology, to "stand for them." For you may be certain that if the work of determining these times is done accurately and thoroughly, the figures obtained will be so far below the results actually being secured in existing shop practice, that the workmen will, in all honesty, refuse to believe that it is possible to attain such rates of production; and indeed, we too, must keep in mind that the attainment of these standard times does not depend wholly upon the workmen, but very largely depends upon the efficiency of the factory management itself in many directions, such as supplying plenty of tools of standard shapes and hardness, proper machine tools and fixtures, and stock properly placed, as well as a method of instructions and demonstrations how the work should and can be done.

It is perfectly obvious that not every workman can possibly attain for some time the rate of speed necessary to do the work within the set time limits. It is equally clear that it is immensely to the benefit of the manufacturer for him to get the working time down to the points determined upon. A flat piece rate based upon these times is manifestly unfair, and an attempt to introduce such rates would probably lead to immediate trouble with the men. I am strongly opposed to any plan that does not provide some form of extra reward to the man for attaining the standard time, this form of reward or bonus to be assured to him with the guarantee that no reductions will be made unless methods, process, or tools be changed.

The method of pay and character of the reward will depend upon the character of the business and the method of pay already in use. I have never favored the forcing of any preconceived plan of any character upon a factory organization or system, if it carries with it the necessity for ripping up existing methods and plans that have become a part of the factory's very daily existence. The old method,

the old systems, possess a momentum that cannot be overcome. So, repeatedly, have I seen the modern systematizer enter the shop organization, upset the existing methods, put in his own pretty theories, only to find, upon returning six or nine months later, that the momentum of the old methods, devised by men who learned the shop's necessities through long and bitter experience, had been too much for his plans and that everything he had done had been, in some inexplicable manner, swallowed up and absorbed by the rolling old system. 'Tis only the theorizer, the man who has not "been through the mill" and who knows not the innermost recesses of the shop processes and cannot read the hidden thoughts and feelings of the members of a shop organization, who rashly promises to "put in a system that will revolutionize the shop and bring up its efficiency."

Rather study carefully the character of the work, the ability of the foremen and workmen, and the systems already in use, and then begin to adapt the new methods to the old—apparently deduce the new methods from the old—and you will have the intelligent support of the organization. And that support that will mean progression to newer fields of thought and activities, and not retrogression to the older methods.

These remarks, fundamental in their importance, apply with particular force to the determination of the wage system to be adopted. The principle of extra bonus for the attainment of standard time can be easily applied to almost any system of pay. Where it cannot be applied directly, the transition to a proper system is usually not difficult.

### Systems of Pay.

The most prominent systems of pay in the United States are discussed below. In England there are many different plans, but these cited herein represent the most prominent in use today.

Day-Work Plan.—This plan, usually decidedly inefficient unless under special conditions, can be easily changed to a most efficient one by applying the bonus idea advanced by Mr. Gantt.

Premium Plan.—An efficient plan on many classes of work. The determination of standard times should, however, be made carefully. If the rates are determined by other methods the plan will eventually fail.

Piece Work.—By this the workman receives a certain amount of pay per piece. A very mischievous plan if it be accompanied by the continual cutting of rates. It cannot be considered efficient when the rates are established according to methods usually practised.

The Differential Plan.—Developed by Mr. F. W. Taylor, of Philadelphia; the piece price varies according to the rate of production. The greater the number of pieces turned out in a given time, the higher the piece price. This can be applied when the "intensity or rate of production" must be high in order to get the utmost out of very costly machinery, tools, etc.

The Bonus Plan.—Explained in detail by Mr. Gantt in his valuable paper read before the A. S. M. E. in December, 1901. Distinctly a system of task work combined with the use of instruction cards for the workmen and a bonus for accomplishing the task within the time set for it.

This bonus system of pay has always appealed to me as the most easily understood, the easiest to introduce with little opposition, and the most effective of all systems yet produced. It is adaptable in some form to almost any other system of pay that may be already in existence in the shop. It is the easiest to introduce in case the men are working upon the day-work basis. Nor is it difficult to persuade the workmen to abandon piece work for it in case the reward is made sufficient. I have been introducing it into works under my control with marked success.

It is of interest to note here, however, that even the closest analysis and study of the possibilities of assembling operations of great intricacy, such as the assembling of the counting mechanism of high-grade adding machine and cash registers, failed to give a positive indication of the possibilities of output in the case of a highly expert workman. The time of actual tests of the intricate assembling when made by the special tester fell far short of the time that could be easily maintained by the workman who, through years of repetitive processes, had gained marvelous skill. The study of his movements by a stop-watch expert would often show but little as regards the possibilities of increasing the speed of the essential operation, though expert observation will probably show that much can be gained by arranging the stock and tools properly and providing ample quantities of stock properly inspected for quality. But the skilled assembler can and will deceive anyone not of the highest order of expertness concerning his possible rate of production, particularly when he has worked for years in the assembling of small parts of great intricacy and where great accuracy is necessary. Therefore, I applied a simple plan of offering the men an additional bonus for every half-hour they gained, in the form of an increase (carefully proportioned according to the length of the job) to their half-hourly wage rate.

I am distinctly in favor of the bonus plan of pay when combined with methods that determine accurately the shortest time in which a job can be finished. It should include a bonus plan for the job bosses and the foremen by which they secure bonuses in case all the men under them earn bonuses. This will result in the foremen immediately giving their close attention to the inefficient workman for his proper and speedy training or his discharge.

### Stock and Cost Keeping.

Much has already been written of stock and cost systems, the subject having been thoroughly covered by a number of able writers in this Magazine. I will not attempt to go into detail and describe any particular cost system, for that has already been well done. Besides, as already stated, each business presents its individual problems so that it is better to consider the adaptation of certain fundamental principles to existing conditions rather than to describe a fully developed system with the thought that it can be transplanted in its entirety to any other factory.

In fact, I shall not attempt within the confines of this article to discuss the theory of cost keeping, nor shall I deal with the problems of distribution of overhead or indirect charges. Rather shall I confine my attention to a description of a very simple and yet effective system of prime-cost keeping combined with the important stock-keeping and stock-tracing systems, which in actual practical use has proven of great value in a number of concerns when properly adapted to existing conditions.

To my mind a cost system should primarily be so devised as to give the manufacturer an accurate knowledge of his *most costly and expensive operations,* so that he may know unerringly these "high spots" and attack them vigorously. With this knowledge he can then devise various ways and methods of reducing costs. Without it he is well-nigh powerless. His stock system should enable him to keep down his investment to a minimum. His stock-tracing system should prove a most effective means of getting his stock through his factory rapidly and without delays. In other words, the practical value of these systems as thoroughly effective methods with which to locate the "inefficient spots," and through which to attack those operations or methods which are excessively costly, outweighs the importance of the theoretical securing of costs simply in order to determine the selling price. The cost system should provide a club with which to beat down costs—the stock-tracing system another club to drive the factory rapidly and economically. Therefore, the stock system, stock-

tracing system, and cost systems are so interrelated as to make it impossible to consider one without the other.

Keeping of Raw Stock.—The stock-invoice card illustrated below will show clearly the nature of the data required to keep such records properly. The problems involved are,

1. The keeping on hand of sufficient raw stock.
2. The placing in the factory of proper amounts of stock for manufacturing purposes.
3. The keeping on hand of proper amounts of finished parts for assembling.

In cases where work is ordered wholly on special contracts, and special material ordered from outside manufacturers, the same simple system can be used with modifications and will prove of equal, if indeed not greater, importance; for in such cases some method by which special raw stock from outside manufacturers can be brought to the shop *on time* is absolutely necessary.

Necessarily the first form is the Requisition for Stock. This is so uniformly used as not to need illustration. It forms, however, a very important and necessary link to the chain.

The next important form is the Stock-Invoice Card. This can be placed at each stock bin or filed in the factory office.

STOCK INVOICE CARD Bin No.

Name and Specifications.....

Am't Used per Mo..... Order Limit.....

Where Used..... Rush Limit.....

| Date | Ordered | Received | Delivered to Factory | Order Number | Inventory | Check No. | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

The most important point to note is the "order limit," or the limit at which new stock must be ordered. If it be raw stock then this limit must be determined by giving consideration to the amount of finished stock required in finished-stock bins, the length of time required to get the stock through the factory, and the length of time required to get the stock from the manufacturers. The "rush limit" indicates a dangerous condition of affairs that must be remedied by using extra efforts. In the case of raw stock the purchasing agent *must be notified immediately and kept after* continually.

In order to have this simple system work properly great care must be used in making all entries promptly and properly. It will be noted that this very simple plan provides a perpetual inventory of great value in many ways. While it does not provide for the combining of factory accounts with the general accounting, still it does provide a very simple, inexpensive, and in most cases a sufficiently accurate method of keeping accounts and values. Reports of raw stock reaching these limits must be made each night to the purchasing agent, a Special Rush List giving those that have reached the rush limit point.

In the case of the finished stock even greater care and vigor must be used. The entries having been properly made, a list giving the amount of those items of stock which have reached the order limit is sent to the stock tracer, who can ascertain whether additional stock should be ordered or stock already ordered hurried in its course of manufacture. A separate rush list showing the amounts of items of stock which have fallen to and below the rush limit should also be given to the stock tracer for his immediate and special attention. In many cases these lists should likewise be given to the departmental foremen, as they are thereby provided with the best possible means of knowing what work to rush.

The system as described is particularly fitted for that class of manufacturing in which the work is standard and many parts can be carried in stock.

In cases where the work is upon special contracts and the work not standard, careful consideration must be given to the time within which each department must do its share of work and turn it over to the next department, calculating of course from the given delivery date of the work. This time should be entered upon the Special Stock Tracing and Cost Sheet which will be illustrated later. (Page 940.)

All cost entries are made from the workman's time ticket. This ticket needs no description. It differs in each factory and each system of pay. It, of course, should contain:

1. Name of the department.
2. Name or number of the piece.
3. The order number and box number.
4. Character of the operation.
5. A full description of the amount of stock received and finished.
6. The price or rate, and total wage.
7. The time started and time finished.
8. Name of workman, foreman, and inspector.

### Storage Platforms.

Wherever possible it is advisable to establish storage platforms in each department. These should be of the height of the moving trucks so as to facilitate the loading and unloading. Each workman should have beside him only the job upon which he is working, and the next job upon which he is to start (with all necessary tools, gauges, clamps, fixtures, etc.). All other stock should be placed upon the platforms. The advantages are many:—

1. The foreman and the shop management are provided with a very close idea of each department's operating condition. An excess of stock shows an unbalanced shop condition. A shortage may prove a like condition in another department, and a too large capacity in the one under observation.

2. A foreman can thus easily apportion the work among his men so that no delays need be encountered. In addition to this he can easily collect the needed tools, gauges, fixtures, and clamps for the next job for each man—exceedingly important features.

3. Should the foreman note that he is running short of any particular stock adapted to any of his machines, he can notify the stock tracer who can easily afford him relief by rushing other departments. This prevents the foreman from running around the shop needlessly.

4. The stock-tracing or routing system is greatly simplified.

5. The taking of inventories is greatly simplified.

### The Stock Tracing and Cost Sheets.

All entries are made upon the Stock Tracing and Cost Sheets by the cost clerks. The rapidity with which these entries can be made by rapid clerks is remarkable. In one factory operating over four thousand men, all entries regarding immense quantities of stock were made upon these sheets by four clerks. A careful examination of this stock tracing and cost sheet shows that herein, in simple form, is contained a full history of each lot of stock in such form as to admit of many uses.

| Operation | Quantity | Department | Date Del'd | Should be Finished by | Date Returned | Time Consumed | | Bonus Time | | Actual Labor Cost | Workman | Machine No. | No. Pieces Lost | Why | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Hrs. | Min. | Hrs. | Min. | | | | | | |
| | | | | | | | | | | | | | | | |
| Totals | | | | | | | | | | | | | | | |

Order No._____ Material { Weight_____ / Cost_____

Name of Stock_____ Total Cost_____

Box No._____ Date_____ Should be finished by_____

THE STOCK-TRACING AND COST SHEET.

1. The stock tracer, notified by his date sheets from the stock clerk of any stock which is running low, can quickly determine those departments in which is located that stock which may be further along in course of manufacture. He can readily force these foremen to produce the stock in time to prevent delays.

2. Delays in any department are clearly indicated.

3. The actual time consumed and the labor cost on each operation are closely indicated. There is provided an analysis that will prove of great value in the hands of one who will systematically hunt for the most costly points in production, with the object of devising tools or methods by which cost reductions can be made. The value of this record in inventories is apparent.

4. Each workman is clearly linked up with his operation. The columns showing "Loss" will provide an index to the efficient men.

5. The data relative to weight and value of raw stock may of course, be adapted to conditions. Whatever the plan pursued it may be very simple. We are thus easily provided with a prime-cost record of great value in devising cost reduction, and in the making of it we are provided with a full stock-tracing system.

As before stated, I shall not attempt to discuss the question of the overhead or indirect charge as this has already been dealt with fully, my object being solely to present a simple and adaptable system which will include the solution to all of the practical problems to be met with in manufacturing.

By using properly the data already upon the time ticket or stock tracing and cost sheet, supplementary reports of value can be made up such as:—

1. The individual workman's record, showing each man's record on each job.
2. The job record, showing the job time and cost record for each workman.
3. The departmental efficiency record, in which output, number of employees, pay roll, and costs are compared.
4. General factory output and efficiency record, showing comparison of output, hours work, pay rolls, and costs comparing one period (either months or years) with one another.

A factory thus equipped with a cost system that will enable the manufacturer to determine the proper point of high cost to attack, with a system of determining standard times, a method of stock location and tracing by which delays are avoided, the whole supported by modern organization and management, can defy competition.

# EDITORIAL COMMENT

TWO correspondents have kindly called attention to a misprint in Mr. Mathot's article on the design of the modern gas engine, by which he appeared to limit the rim velocity of a band fly-wheel to 500 feet per minute. The correct figure, of course, is 5,000 feet. Mr. Mathot even admits 5,500 feet as not impracticable where the fly-wheel carries the belt, and 6,000 as a speed often reached in good practice when the fly-wheel runs light.

Out of the correspondence between our contributor and one of the correspondents just referred to has developed a commentary upon certain differences between Continental and American practice, so interesting that we are glad to reproduce it (with the consent of both parties) for the benefit of a wider circle of readers. We quote first from a letter of Mr. Randolph T. Ode, secretary of the Providence Engineering Works. Referring to the formula given on page 440 of our June issue, Mr. Ode says:

"I have used this formula for a great many years on steam-engine work, and was much pleased to notice that it was applied by Mr. Mathot to gas-engine work.

"We differ, however, with Mr. Mathot as to some of the constants he recommends for use in gas-engine work, as we do not think they are consistent. For example, the constant that he uses for Otto-cycle engines, single-acting, single-cylinder, of 44,000, is nearly six and one-half times that which would be used for a double-cylinder tandem double-acting engine. However, that is a matter of opinion.

"Another question we would like to have answered: In a preceding part of his article, Mr. Mathot refers to a difference in governing between the hit-and-miss method of operating a gas engine and the throttling method of operating, but he does not give us information as to which system these fly-wheel constants, etc., in his formula apply to, leaving another source of confusion in the reader's mind.

"Then, too, I would differ also in the constants that Mr. Mathot uses for ordinary electric lighting by continuous current, etc., as compared with direct currents and the like and alternating-current generators in parallel. That again, however, may be a matter of experience; but our experience, which extends over many years in high-grade steam-engine construction, does not warrant the tremendous differences, which amount to 1 to 6 as exemplified as gas-engine constants.

"Mr. Mathot also states on page 431 of his article (THE ENGINEERING MAGAZINE, June, 1907): 'So far as general practice is concerned, it must be realized that there is no reason whatever why the substitution of an explosive mixture for steam should cause any material difference in prime movers'; and after making this remark he makes no statement whatever as to the merits of the overhung double-crank system, according to European practice, as compared with single side-crank construction which is being adopted by a majority of the American builders. This is an exceedingly important point, and one which I know very well has been brought to Mr. Mathot's attention very often before this.

"If you can kindly do so, to make his article more complete, we would like to secure his opinion."

Mr. Mathot's reply to the queries was cordial and comprehensive, and from it we make the following abstract:

"No slip has occurred in giving the constants to be used for the calculation of fly-wheels, and the constants K suggested are determined by both theoretical computation and practical experience. Whatever the difference may seem to be between the constant for the single-cylinder single-acting engine and that for the tandem-cylinder double-acting, the figures are right.

"Of course, the constants refer to improved systems of governing; for I consider that the 'hit-and-miss' method, while it gives very good results on small engines, should not be applied to engines of more than 25 horse power. Further, I do not think there is any valuable example of the application of the hit-and-miss to large engines of the double-acting tandem or double-acting twinned tandem types.

"Regarding the permissible grade of irregularity—or amount of variation during a single revolution—the figures I have given agree with the best technical practice and are those used by the leading experts on the Continent. Of course, these figures cannot be compared with steam-engine practice. I should cite the statements of authorities from which it would appear that to reach the same regularity with a four-cycle single-acting gas engine as with a single-cylinder steam engine, the fly-wheel must be 9.3 times as heavy, or must have a rim velocity 3.05 times as great ($\sqrt{9.3} = 3.05$).

"The statement quoted by Mr. Ode—that 'there is no reason why the substitution of an explosive mixture for steam should cause any material difference in prime movers'—is to be qualified by the clause limiting this to structural features. This, of course, relates to the steadiness of the frames, the mode of fastening them to the foundations, the provisions for inequality of expansion, etc., but not to regularity of running.

"Concerning the question of single *versus* double crank, in which young American practice seems to be quite different from the older European practice, I have already set forth that the determination whether the side crank is better than the center crank or *vice versa* is to be solved by future experience. I should observe, however, that so far as my own knowledge goes, the adoption of the side crank is limited to the Allis-Chalmers, the Power & Mining Machinery, and the Westinghouse companies, whilst in Europe the engines made on the double-crank system now aggregate about 450,000 horse power. The first large engine for blast-furnace gas, one of 200 horse power, was built by those pioneers in large gas-engine work, the Cockerill company, on the side-crank system; but since then no further attempt has been made in that line. In any case, there is no doubt that the use of the side crank necessitates much larger shafts and much heavier bed frames than that of the centre crank maintained between two bearings, without any overhang.

"It is perhaps true that the single crank better meets the conditions of American practice, because of the difficulty of getting highly skilled mechanics and fitters for the erection of these large engines. This trouble is overcome by the simplicity attending the accurate fitting in line of two bearings instead of the three which are necessary when the bed frame has two bearings, one on each side of the fly-wheel, and a third bearing is provided at the other side."

Mr. Mathot expresses his very active willingness to answer any further questions, but the points already elaborated will doubtless be welcome to many readers, whose thanks will be

offered to both our correspondents for the discussion. It is Mr. Mathot's strong conviction that gas-engine work has too often started *de novo,* with too little interchange of study and data among the various investigators, and too little use of the fund of experience accumulated both in theoretical investigation and practical use of the steam engine. This pleasant sequence to his series of articles suggests the profit attending a frank comparison of views between independent expert authorities, especially when this interchange of opinion can be given that international range which it is the happy province of THE ENGINEERING MAGAZINE to facilitate.

* * *

WE have referred in these pages, with a frequency which may seem like persistence, to the possibility and the need of some readjustment of our higher courses of technical education which shall bring and keep them closer to the industrial requirements of the times. The school of applied science, at its inception, was first of all an institution to provide men soundly trained in the new and rapidly enlarging field of occupation provided by the expansion of engineering and its allied professions; but secondly, it was a revolution on educational ideals—a secession from the ultra-classical forms into which the older university courses had crystallized. It was an assertion that mental culture could be made liberal and at the same time useful. But—following a tendency which has always characterized all forms of dissent—it shows some signs of itself becoming over-formalized or over-classicized. The opinion is too often expressed that the young technical graduate is too solicitous for technical ideals and unfamiliar with economical limitations; that, as Mr. W. M. McFarland has so aptly put it, he is so indoctrinated with the saying, "The best is good enough," that he does not give large enough place to the often necessary antithesis, "Good enough is the best." Another interesting commentator phrased it more radically: "We could do with less calculus and thermodynamics, but would like more sound, practical industrial economy."

Perhaps the most striking instance of the lack of exact parallel between the engineering schools and the modern developments of engineering occupation is the lack of any adequate provision for the student whose life work is to be the superintendence of a manufacturing plant. There, at least, more room should be made than any of the schools has yet afforded for instruction in factory conditions, the influences which affect the economy of production, methods of organization and operation, wage systems, the supervision of work and of material, and the analysis of costs with a view to cost reduction. A beginning is being made by some of the most advanced colleges, but in our opinion the full possibilities will not be realized—either in this course itself or in its helpful influence in making other engineering courses more practical—until the subject of "works management" is given a standing and a proportion equal to that afforded to stationary, marine, or locomotive engineering.

REVIEW OF THE ENGINEERING PRESS.
"THE WORLD IS ITS FIELD"

# THE QUALITY OF STEEL RAILS.

SUGGESTED IMPROVEMENTS IN THE PROCESSES OF MANUFACTURE OF BESSEMER STEEL RAILS.

*Henry M. Howe—The Engineering and Mining Journal.*

ONE of the most important metallurgical problems of the day is the improvement of the quality of steel rails. In the early history of railroading bessemer-steel rails, relatively low in carbon and high in phosphorus, were able to give satisfactory service under the existing conditions of manufacture and traffic. The conditions of service have, however, changed much more rapidly than metallurgical practice has advanced, and higher speeds and heavier trains have demanded qualities in rail material which the bessemer process has not been able to supply. At the present time attention is being drawn to the problem more strongly than ever before on account of the frequent breakages of rails in service and the numerous derailments due to this cause. This element of danger in railway operation has no doubt been greatly exaggerated by popular clamor, but it is nevertheless very real, and it is to be hoped that earnest co-operation of manufacturers and railroad men will result in a speedy and satisfactory solution of this problem. In a recent number of *The Engineering and Mining Journal*, Prof. Henry M. Howe of Columbia University gives an interesting review of possible improvements in processes of manufacture, from which the following extracts are taken.

With light wheel loads a 70-pound rail with 0.10 per cent. phosphorus and 0.35 per cent. carbon gave satisfactory service, but the rapid increase in wheel loads soon necessitated the reduction of abrasion by the use of a harder rail material, that is, one higher in carbon. The increase in the carbon content of steel had a great effect in intensifying the embrittling influence of the phosphorus and the brittleness of the steel was further increased by a variation in the process of manufacture which materially raised the temperature at which the rolling of rails is completed. Hence, to make rails safe for present conditions of traffic this brittleness must be lessened by reducing the phosphorus content of steel and lowering the finishing temperature. Sufficient low-phosphorus ores are not available to supply the great demand for steel rails and a dephosphorizing process must be resorted to. The basic open-hearth process removes practically all phosphorus but it would be impossible to discard the bessemer process for a great many years at least. In the meantime means must be found to improve the bessemer process and remove the defects which cause the brittleness of the steel product. The bad effects of phosphorus can be greatly reduced by restraining segregation.

"In order to lessen the degree of what we may call residual segregation, the segregation which remains in the finished rail, I advise three steps: first, free use of aluminum; second, extremely slow pouring, and third, greater discard from the top of the ingot.

"The use of aluminum will lessen segregation materially, but it will lengthen the pipe; or where no pipe exists it will increase the tendency to piping. This tendency in turn will have to be met by crop-

ping off and discarding a larger part of the top of the ingot."

Extremely slow pouring will counteract the pipe-lengthening effect of the aluminum in that it should both shorten the pipe and raise the segregate toward the top of the ingot. The pouring should be as slow as possible without allowing the whole heat to cool so much as to form a ladle skull. Means of increasing the practicable slowness of pouring would be to cast two or more ingots simultaneously, either through separate nozzles from a single ladle or by means of a distributing funnel, or to keep the steel in the ladle artificially heated by burning oil or gas on top of it.

"The richest of the segregate lies near the top of the ingot, usually in the upper 20 per cent., often in the upper 10 per cent., of its length. There is good reason to hope that, by means of slow pouring, it can always be kept in the upper 10 per cent., even if aluminum is used freely. To increase the discard of course is to increase the cost of a ton of finished rails, and to lessen the output of finished rails. However much this may be regretted, it may prove to be a necessity. It is idle to crop off only the mechanically unsound top part of the ingot, and leave just below the most dangerous, because the most segregated part, the part in which the phosphorus from the whole ingot is concentrated.

"The degree to which the cost would be increased and the output would be lessened by increasing the discard, has been overestimated by many hasty writers. They have assumed that a discard of say 20 per cent. would decrease the output by 20 per cent., forgetting that there is already a very considerable discard, and that it would be only the excess of the proposed discard over the present that would decrease the output.

"It is well known that within certain limits the higher the temperature at which the rolling of the rail ends, the more brittle will the rail be; and that the power of the rail to endure shock is increased by continuing the rolling process until the temperature has sunk to a point at which the metal itself has become so hard that further reduction by rolling becomes extremely difficult. The trouble in applying this principle has been that, while it is easy enough to arrange matters so that the rolling of the thin web and flange of the rail shall continue till these parts are properly cool, yet, because the head of the rail is so much thicker than the web and the flange, and because it therefore cools so much more slowly than they, it still remains very hot at a time when they have already grown so cool and hard that it is not practicable to reduce them farther by rolling. On this account the rolling ceases while the head is still far too hot, and through this the metal in the head is seriously injured.

"But this condition of things, though convenient enough as far as the mere administrative work of rail making is concerned, is not necessary, if indeed it is intelligent, Today we may question whether it is tolerable. If, as I understand, it is to the interest of the railroads that their rails shall have the greatest attainable power of resisting shock, some method of lowering the finishing temperature of the rail head should be sought. What that method shall be it is for rail-making experts to decide. That some practicable method can be found we can hardly doubt.

"To bring this about by some change in the procedure in rolling may be possible, but the difficulties are certainly very great. The usefulness of the Kennedy-Morrison process of setting the rail aside to cool for a short time just before the last pass, has been challenged on the ground that the reduction which the final pass gives is too slight to improve the condition of the railhead materially. This in turn probably rests on the further fact that, when the rail has grown as cool and rigid as it is at this last pass, it is not practicable to reduce one part, say the head, materially more than any other part, say the flange; because if we did, the greater reduction of the cross-section of the head would elongate the head in the direction of rolling, or parallel with the length of the rail, so much more than the flange, as to camber the rail very seriously. Such unequal reduction by means of what is called an 'unbalanced pass' can be resorted to earlier in the rolling operation, when the metal is so soft that the camber thus caused is immediately effaced by the collars of the rolls, or by suitable pieces attached for that purpose; but at the end of the rolling, when the

metal has grown rigid, this effacing of a serious camber is impracticable. Hence, after the rail has been set aside for cooling in the Kennedy-Morrison process, all the reduction that can then be given to the head is the slight one which can simultaneously be put upon the rigid web and flange, a reduction so slight that it does not remove the injury caused to the head by its exposure to the high temperature.

"Like considerations stand in the way of another plan which naturally suggests itself. That plan is to adjust the passes in such a way that the flange and web shall reach their final size, or come very near to it, at a time when the head is still much larger than its final size; and then in the subsequent passes give only very slight reduction to the relatively rigid web and flange, but heavy reduction to the head, which would thus meanwhile be cooling continuously.

"But here, as before, the difficulty arises, that reducing the head materially more than the flange in these proposed last passes, would cause a camber so strong that to remove it would be difficult if not impossible.

"Another and an expensive way would be to change the section of the rail in the direction of making the web and flange much more nearly of the same thickness as the head. The present design is based on civil engineering rather than on metallurgical considerations. The web, because it is so near the neutral axis, does not, from a purely civil-engineering standpoint, need to be very thick. The flange, made very broad so as to prevent the rail from being overturned by side pressure, and also so as to prevent its cutting into the tie, does not need great thickness from a purely civil-engineering standpoint. But the head has to be made thick, in order to endure the concentrated wheel load applied to its upper surface. Manifestly, the head cannot be wide and thin like the flange; it must be thick and relatively narrow. . . . . But there is no reason beyond that of expense why the web and flange should not be heavier; indeed why they should not be approximately as thick as the head. If they were, then the cooling of the web and flange would not thus outrun that of the head, and the rolling of the whole could continue until not only the web and flange, but also the head, had cooled off to a proper finishing temperature."

Prof. Howe considers that the drying of the blast, which is often advocated as a means of improving the bessemer product, would have little or no effect. Variations in the temperature of the converting operation are caused by so great a number of circumstances that it is not likely that the removal of variations of the amount of moisture in the air would lead to much improvement, particularly as this is by no means the greatest of the causes contributing to variations in the rapidity of the blast. Finally but little assistance is to be derived from electrical purifying processes for removing phosphorus as at the present stage of their development they are so expensive as to be absolutely unavailable.

## THE ENFORCEMENT OF SPECIFICATIONS.

A DISCUSSION OF THE PRECAUTIONS WHICH MUST BE OBSERVED TO SECURE THE DELIVERY OF SATISFACTORY MATERIALS.

*Dr. Charles B. Dudley—American Society for Testing Materials.*

THE development of specifications has been one of the most important and far-reaching results of the advance of knowledge of the properties and strengths of materials and of methods of testing. When first used, the specification amounted to nothing more than an attempt on the part of the purchaser to give the producer an idea of his needs. Later it became a demand, often couched in such terms as to antagonize the manufacturer. In its present development it amounts to an agreement, of which both producer and consumer approve and from which both expect to derive benefit. Being of the nature of a compromise in which differences are harmonized and conditions arranged to the satisfaction of both parties, it would seem an unnecessary waste on the part of the purchaser to take elaborate precautions to secure the en-

forcement of the contract, provided that the manufacturer is accounted a man of honesty and integrity in his business relations. That such precautions are necessary, however, was interestingly pointed out by Dr. Charles B. Dudley in his presidential address before the recent annual meeting of the American Society for Testing Materials.

"There are so many conditions leading to the manufacture and delivery of unsatisfactory materials, that is, materials that do not fill the requirements of the specification on which they were bought, which conditions do not involve the business integrity, or the honest intention on the part of the producer to do as he has agreed, that we are sure no one need feel aggrieved at the establishment and maintenance by consumers of devices for the enforcement of their specifications. No one believes more devoutly than we do, that with few exceptions, that are so few as to be almost ignorable, producers in general prefer to do an honest business at a fair price and profit, and that they always would do so, if—it were not for certain conditions. What, then, are some of these conditions?

"The first condition which leads to the tender of unsatisfactory materials is, improperly worded or unreasonable specifications. It is obvious that the viewpoint of those having to do with either the making or carrying out of specifications being different, and in a sense antagonistic, since their interests are naturally and legitimately opposed, the meaning which they attach to words will be different, and both parties may be equally honest. In like manner an unreasonable requirement in a specification, may lead to the same result. Our friends, the steel manufacturers, are constantly being presented with specifications containing stipulations which it is impossible or at best, only occasionally possible to fill. Those who have made these specifications have, we fear, neglected one of the prime requisites of a good specification, viz.: to consult with, and on certain technical points, be guided by the best manufacturers."

The mistakes of subordinates are a frequent cause of the delivery of unsatisfactory materials. Sometimes these are mistakes pure and simple; at other times they arise from an excess of zeal on the part of the subordinate who will include inferior material in a shipment under the impression that he is doing his employers a service. It must also be remembered that commercial processes do not always yield what is expected of them notwithstanding every effort on the part of the producer to secure a satisfactory result.

"A contract taken at too low a figure is a fertile cause of unsatisfactory materials. Under stress of competition agreements are made that if carried out strictly in accordance with the specifications, would result in loss, or lack of reasonable profit. Again, strange as it may seem, a very large number of manufacturers of commercial products, as a matter of fact do not know the characteristics of their output. They have been making and selling their staple for a period of years, it may be, and as long as the consumers accepted the material, and raised no questions, they themselves saw no need of making tests and experiments, except perchance such as would lead to diminution of cost in manufacture. Accordingly very little or no knowledge was obtained of those qualities of the material which are of most interest to the consumer. And yet, without that knowledge, contracts are taken and shipments made. Again the tender of unsatisfactory material is often explained after it has been tested and found wanting by the statement that although it may not quite fill the requirements, it still is good material and will do the work. Of course it takes but a moment's reflection to lead any fair minded person to the conclusion, that this statement is not at all the question at issue, and that if the consumer had been willing to use a material that is, in the language of the shops, 'just as good,' he would have specified such material, and obtained the benefit of a corresponding variation in price."

A sudden shortage in the raw-material supply often leads a manufacturer to substitute inferior material for that specified, on the ground that delay would otherwise be caused. Such an argument should, of course, never prevent the rejection of the unsatisfactory material, and the same may be said of the argument often advanced by tenderers of inferior materials that de-

lay will be caused if these materials are not received and used. In the first case, a frank statement of the conditions by the manufacturer would generally result in an extension of the time of delivery and remove the difficulty; for the latter there is no excuse and no remedy.

"If we have succeeded in what has been said, it is evident that there is necessity for the enforcement of specifications, and that, too, without assuming that men are dishonest or do not intend to do as they have agreed. Under present commercial conditions, and with our present knowledge of the properties of materials and of the processes by which they are made, it simply would not do for the consumer to leave his interests wholly in the hands of the producer. Each must look out for his own interests, and be prepared to defend and maintain them. Perhaps we have said more than is necessary on this point, but the practice of buying and using materials on the reputation of the maker is so deep-seated and widespread, and has for so many years been the refuge of engineers in cases of failure, that perhaps the subject will safely bear elucidation at a little greater length than would otherwise have been admissible.

"But how shall specifications be enforced? What are the essentials of successful enforcement? We reply, first, the examination and testing of the material tendered must be so planned as to be efficient and leave no loopholes for evasion or substitution of inferior materials. In the case of some substances, every shipment must be tested. In the case of others, as for example, materials that are produced in heats, or are stored in tanks or bins, the tests deciding their fate may be construed to cover the whole amount even though there may be a number of deliveries. The essential feature is that each test or lot of tests shall cover a definite amount of material, and that nothing shall be left to the honesty and good intention of the producer or shipper. If we are going to trust the producer in one detail we may as well trust him in all. The strength of a chain is the strength of its weakest link. No universal rule can be given, but assuming that the specifications are wisely drawn and provide only essential tests, these tests must be so applied as reasonably to cover all the material that is delivered."

Dr. Dudley points out the following essentials of effective sampling. In the first place, a representative of the consumer must always take the sample because, as has been already explained, it is neither reasonable nor safe to trust the producers in anything by which the validity of the tests might be affected. A second point, which is almost always covered by the specifications, is that the sample must be representative of the whole shipment or lot under test and should also represent a definite amount of material. The sample should be taken at random and not always from the same place. Familiarity with the methods of an inspector opens the way to imposition and fraud, particularly in those establishments where the subordinates are paid according to the amount of successful output and are thus liable to make "unintentional mistakes." Finally, sampled material should not remain in the hands of producers unless absolutely necessary. If it cannot be removed at once it must always be marked in such a way that substitution would be impossible. The chances for "unintentional mistakes" are too numerous and such mistakes too common to permit of any uncertainty on this point.

"Let us assume that the specification has been wisely drawn, that a shipment has been properly sampled, and that the tests show that it does not fill the requirements. What is the next step? As a matter of fact in our own daily work, but one thing is ever done, and that is, the material is rejected. None of our specifications provide for a second or third sampling and corresponding tests. Our theory is that the material ought all to be of the grade called for by the specifications, since this is what the consumer has bargained for, and if this is the actual fact, one sample is as good as fifty. We are quite well aware that there are many specifications in force, which provide for second, and if need be, third tests, the fate of the shipment to be decided by the majority. But this has for a long time seemed to us to be a survival of the crude early days of testing, when neither producer nor consumer knew much about materials, and which it is high time should be banished forever. If a specification is so

severe that only two-thirds of well made material will stand test, the specification should be changed, and if a manufacturer can only make a product two-thirds of which will stand test, he should either learn how to improve his product or go out of business. Testing was never intended to be a device to bring about the acceptance of inferior material; but quite the contrary. Moreover, from three samplings and tests, it is but a step to five or seven or nine, and perhaps if sampling and test is long enough indulged in, a majority may ultimately be found which will always bring acceptance of the material. Surely the interests and responsibilities of the consumer cannot be trifled with in this manner.

"This whole matter of multiple tests, retests, and the disposal of unsatisfactory material can, as it seems to us, be summed up in a few words. Multiple tests are pernicious and should be abandoned. Retests, including the sampling, should never be made unless there is reasonable evidence to think there is an error somewhere in the first test, and to decide this point every reasonable facility should be furnished by the consumer to the producer, to enable him to satisfy himself. Shipments of material once fairly rejected should never be accepted and used if the material is of such a kind that safety or risk to human life is involved, and finally, it is suicidal, and brings with it a train of almost unmanageable subsequent conditions, to accept rejected material in which only commercial considerations are involved, unless there is some abatement in price."

## THE FACTOR OF SAFETY IN STRUCTURES.

A DISCUSSION OF THE IMPORTANCE OF WORKING STRESSES AND FACTORS OF SAFETY IN STRUCTURAL DESIGN.

*A. N. Talbot—Bulletin of the Engineering Experiment Station, University of Illinois.*

THE term "factor of safety" was apparently invented by the pioneers of modern constructive engineering in an endeavor to remove the popular idea that metal construction could never be made as safe as wood or stone. Since those early days, experience and research have continually added to our knowledge of applied mechanics and strength of materials, but the use of factors of safety has, in general, lost but little of its vagueness and is even now governed by precedent and convention rather than by an exact conception of their functions. It has been remarked repeatedly that the study of the "unutilized material" in structures is of fully as great importance, as regards both strength and economy, as that of the utilized portion, but engineering research has confined itself almost exclusively to determinations of strengths, capacities, etc., and has left the principles on which correct factors of safety for various materials and types of construction may be determined almost uninvestigated. In his recent report on Tests of Concrete and Reinforced-Concrete Columns, forming Bulletin No. 10 of the Engineering Experiment Station of the University of Illinois, Prof. A. N. Talbot makes the following comments on the importance of the factor of safety in structural design, with particular reference to concrete structures.

"The real basis for a working stress or a factor of safety to be used in designing seems not to be generally understood, or at least it is not often properly explained, and expressions sometimes heard indicate that the purpose and use of factor of safety and working stress are misinterpreted. Of course, no engineer will say that for a factor of safety of, say, four (using the term factor of safety as based upon the ultimate strength of the material) the structure will take four times the assumed load without injury. It is understood by engineers that the actual ratio of the load which the structure may properly take under the ordinary conditions of construction to the assumed load used in the calculations made in the design is not large and may, under some circumstances not be very much above one. Yet the statement is sometimes made, or the inference may be drawn, that because a given working stress is to be used in the calculations there is no advantage in looking into the behavior of the material or the action of the structure at a stress

higher than the assumed working stress. It may, therefore, be well to consider some of the aspects of working stresses and factors of safety.

"Mild steel has a rather definite elastic limit and yield point beyond which the character of its action changes in a marked way. Beyond the yield point the rate of stretch in tension becomes almost at once one hundred or more times as much as it was within the elastic limit. In compression, the ultimate strength of mild steel is not far beyond its elastic limit. It is evident that a structure made up of this material will distort and fail when a load producing stresses not much greater than the elastic limit is placed upon it. The elastic limit of mild steel has a small range, its value running from 50 per cent. to 65 per cent. of the ultimate strength, depending upon the size of the piece, method of rolling, etc., and the steel is made under such conditions that little risk is taken in choosing a value for a particular size and shape of piece. The modulus of elasticity of steel is also quite uniform. It may be said then, that the properties of this material, with proper inspection, are fairly definitely known. When we base the factor of safety of a structure upon ultimate strength of mild steel, whether we do it consciously or unconsciously we have tacitly assumed that the factor of safety named in the calculations is nearly double the factor which will bring actual failure under the conditions assumed to exist in the structure.

"For a plastic material, or a material not having a definite elastic limit, or at any rate one for which the stress varies directly as the deformation for at best only a small part of the ultimate strength of the material, a different consideration must be given. For such materials, the effect of lack of uniformity of the material, the effect of increased deformation, of repetitive loading, of time, and of other factors must be considered.

"But there are other considerations which go to confine the working stress, particularly in concrete, to the low value usually assumed. Sometimes the stress is made low to allow for a possibly greater load than that assumed, or for a load applied other than statically. Even if the assumed load has the correct total amount, the following items may be said to influence the choice of a lower working stress: (1) Uneven distribution of load among members; (2) Unconsidered stresses due to settling, variability of the material, etc.; and (3) Variation in the material and in its farbrication.

"(1) Even with a load of the amount assumed, the division of this load among the members of the structure may be uneven. Variations in stiffness, differences in quality of adjacent members due to inherent variations or to the variations which arise in such a material as concrete during fabrication and setting, differences due to restraint or lack of restraint at connections—all go to make the actual distribution of the load different from its assumed division among the members. In a timber trestle bridge, the weaker stringer is generally less stiff than its stronger neighbor, and hence the poor stringer takes a smaller share of the load and the good one a greater. Even in steel building construction, differences in rigidity of connections, modifications made to overcome lack of exact fit, and variations caused by field riveting act to modify the division of the load. In concrete construction the variations in fabrications and conditions of setting (*e.g.*, in the beams and girders) and the consequent variable effect on stiffness and restraint may have a considerable effect upon the division of the load. This is especially true in the floor, beams, and girders, so that the load transmitted to a particular column may be quite different from that assumed.

"(2) Settling of the foundation of one column more than of another is possible. A variation in the shrinkage of adjacent columns through variation in conditions attending fabrication or to a less extent in porosity or stiffness of column will modify the distribution of the load. Variations in size also affect this distribution. The more nearly uniform the dimensions and physical properties, the more nearly regular the division of load will be and the higher the allowable comparative working stress. In this respect, steel is an advantageous building material.

"(3) The values of physical properties usually quoted are average values. The

data were obtained from test pieces, sometimes large, frequently small, and these may be said to have been made and tested under favorable conditions. Since the members of a structure which have the poorest quality may have a controlling influence upon the amount of load to be carried, if average values are used the factor must be greater to allow for this. In other words, in poorly made beams or columns the load or stress which comes on the piece is relatively nearer the point of failure than is indicated by the use of the assumed working stress and an average ultimate value.

"Enough has been said to show that the assumed stresses are not the actual stresses coming upon the members of a structure and that the relation between the assumed working stress and the average ultimate strength of the material is a matter which should involve thought and study. It may then be stated that (a) the stress actually brought upon a member of a structure by an assumed loading may be materially higher than the assumed working stress, and (b) the stress actually developed in a member may be much higher comparatively (*i. e.*, with respect to its own ultimate strength) than even this increased amount would indicate. This goes to show that the nature of the action of the material, including its stress-deformation relation, should be studied at points well above the assumed working stress. What point should be fixed upon as a basic point, upon which a working factor covering uneven distribution of load, uncertainty of quality, effect of repetitive loading, etc., may be based, will depend upon the nature of the material and the condition of the structure."

## THE DURABILITY OF REINFORCED-CONCRETE STRUCTURES.

THE CONDITIONS LIKELY TO AFFECT THE DURABILITY OF REINFORCED-CONCRETE CONSTRUCTION AND THE PRECAUTIONS WHICH ARE NECESSARY.

*F. E. Wentworth-Shields—Institution of Civil Engineers.*

A PAPER presented at the recent Engineering Conference of the Institution of Civil Engineers forms an interesting supplement to Mr. Collins' remarks on reinforced-concrete as a construction material on another page of this issue of THE ENGINEERING MAGAZINE. The paper, of which the following is a full abstract, deals with the conditions likely to affect the durability of reinforced-concrete structures and the precautions which should be observed in designing:

"Probably one of the principal reasons why English engineers have hitherto hesitated to introduce reinforced or steel concrete is that it is difficult to speak with certainty about its durability. Only fifty years have elapsed since Monier first used it, and only about ten years since it was employed on any scale in this country; so that it is not yet possible to point to any work in steel concrete which has stood the test of centuries, and all we can do is to look at existing structures, and notice carefully how far they have suffered, and what repairs have been necessary. In so doing we can not only form an idea whether steel concrete is likely to be long lived, but also what precautions are necessary when designing in order to render it so. The chief things which we should expect to shorten the life of reinforced concrete are:—

1. Settlement of foundations.
2. Fire and earthquake.
3. Atmospheric change (rust, etc.).
4. Abrasion and collision.

"1. Dealing first with settlement of foundations, it may be said that steel concrete is a rigid material, and the foundations of a structure of this substance ought to be designed in such a way that they cannot settle. This can always be done even on soft ground, either by piling or by spreading the weight over a large area, on a strong reinforced-concrete base. An instance of the evil of neglecting this precaution was to be seen at the Kom Ombo pumping station in Upper Egypt last year. A culvert of reinforced concrete 10 feet in diameter was laid in the Nile silt. The ground had evidently been disturbed beneath it, and the culvert settled down, producing transverse cracks in the concrete. The water escaping from these cracks no doubt aggravated the settlement, and by

the time the culvert came to rest the leakage of water was so serious as to necessitate its being abandoned.

"2. Reinforced concrete is undoubtedly a first-rate fire-resisting material. Many experiments have been made to test this, but perhaps one of the most striking proofs is the fire which occurred a few years ago in a warehouse in Baltimore. Not only were the contents of the building destroyed, but its brick walls almost entirely collapsed; the floors, however, which were of concrete reinforced on the Hennebique system, and supported on steel concrete columns, remained intact. It would seem that for fire-resisting purposes it is best that the steel should consist of many bars of small section in preference to few bars of large section, as the first arrangement forms close net-work, which prevents pieces of concrete from dropping out and so reducing the strength of the building. It is also important the concrete aggregate should be crushed small. The ideal composition for the aggregate would seem to be a strong flint or granite for the hearting, with an outside skin of cinder concrete to act as a good non-conductor. It is essential that in a building, the walls, floors, and posts should be well tied into one another.

"There is a tendency nowadays, in designing steel-concrete buildings, to reject that material for the walls on the score of expense, using it only for floors and columns. Sometimes a compromise is made; for instance, at the tobacco warehouse now being built at Bristol on the Coignet system, the walls consist of a framework of steel concrete with brick panels. This is probably the best arrangement, as, although brickwork is undoubtedly more economical for walls than steel concrete, still the latter is much less inclined to collapse under fire. The brickwork can be arranged, as at Bristol, to conceal the concrete entirely, but the collapse of any part of the brickwork would not endanger the floors or the concrete framework.

"With reference to damage by earthquake, reinforced concrete was subjected to an excellent test in the San Francisco earthquake. The museum building at the Leland Stanford University had three wings, one of reinforced concrete and two of brickwork. The building received a very severe shaking, and while the brick wings were in a state of collapse, the damage to the steel-concrete wing was insignificant.

"3. We have had enough experience of concrete to know that, if good, it is practically unaffected by atmospheric changes. At one time it was feared that the steel might rust, especially in structures under water, but this fear seems to be groundless. Some recent experiments on the permeability of concrete by Mr. Baldwin Wiseman show that, if well made, it is one of the most water-tight materials known, and that it rapidly becomes less and less porous when water is forced through it. Moreover, some experiments quoted by Mr. Marsh in his work on "Reinforced Concrete" seem to show that cement has some chemical action on iron which prevents rust. At all events, a recent examination of three steel-concrete quays at Southampton standing in water convinced me that there was nothing to fear on this score, provided, of course, that the concrete is not accidentally knocked off, and that it is of good quality.

"Some experiments recently communicated to the American Institute of Electrical Engineers raised the alarm that steel rods immersed in damp concrete rust rapidly when mild electric currents are passed through them. To this the best answer is that well-made concrete should not be, and generally is not, damp. It will have been noticed by those who have had to cut out good steel-concrete work that, although recently immersed in water, the concrete and steel were both dry and clean, and that the water appeared unable to penetrate even the inch or two of concrete which covered the steel. However, the risk should not be overlooked, and care should be taken to exclude electric currents from steel-concrete work as much as possible.

"4. It has been stated that steel concrete has far more resistance to abrasion from shipping or other floating objects than timber, but my experience at Southampton convinces me that this is quite exaggerated praise. On the contrary, if reinforced concrete is to be used for marine work, it must be carefully fendered at all parts where it is likely to be struck. In most systems of reinforced concrete the steel is placed within an inch or two of the sur-

face, and if the structure is not protected by timber cushions, this concrete skin is easily knocked away, leaving the steel naked and liable to rust. At the same time it is true that steel concrete does not spall easily from blows, provided they do not fall directly on the concrete; and it will stand a wonderful amount of shocks, and bending due to shocks, if a wooden fender is interposed.

"The coaling-jetty at Southampton (completed 2½ years ago) suffers as much, perhaps, from the blows of ships and barges as any steel-concrete structure yet made. It is protected by fenders of American elm, and in spite of blows which have caused the whole jetty to sway, there is no sign as yet of the concrete spalling off, except at one or two places where the blow has fallen directly on the concrete.

"Speaking of this jetty calls to mind an interesting piece of repair-work which was carried out there about two years ago. A steamer collided with the quay, breaking two piles and the beams they supported. On examination by divers it was found that the piles were broken down to a level of 12 feet below low water. The work of repairing the quay, however, turned out to be fairly simple; the broken concrete and steel rods were cut away by divers, who also erected new rods to take their place. These new rods were joined to the undamaged part of the old ones by steel tubes, and the stirrups or binding-wire were placed round the new rods at correct intervals. A watertight casing of timber was then placed round the pile, which extended from the undamaged portion to above low water. From this casing the water was pumped out, and the concrete was filled and rammed into the box in the ordinary way. Above low water the piles and beams were remoulded in just the same way as they had been originally built. This shows how easily and effectively steel concrete can be repaired.

"On the whole, it may be said that our experience goes to prove that reinforced concrete, if well designed, is likely to be one of the most durable building materials, if not the most durable, that can be found."

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## ENGINEERING SCHOOLS AND POLYTECHNIC EDUCATION.

A DISCUSSION OF THE DUTY OF ENGINEERING SCHOOLS IN PROVIDING INSTRUCTION FOR FOREMEN AND SUB-SUPERINTENDENTS.

*Dugald C. Jackson—Society for the Promotion of Engineering Education.*

THE scarcity of skilled workmen, and particularly of artisans fitted for the lower positions of responsibility and superintendence in manufacturing establishments, is generally admitted to be one of the most pressing problems in industrial operation of the time. The revival of the apprenticeship system on an extended scale by several of the larger concerns will, no doubt, solve the problem in these few individual cases; but the manual-training schools and trade schools, on which the bulk of the manufacturing industry of the country must depend for the technical training of foremen and operatives, are utterly inadequate in numbers, equipment and instruction to supply the ever-increasing demands of industry. Dugald C. Jackson of the Massachusetts Institute of Technology, in his presidential address before the recent annual meeting of the Society for the Promotion of Engineering Education, considers that the supplying of the "corporals and sergeants" of industry is a function of the engineering schools no less important than the training of professional engineers, and he lays the blame for the present state of affairs on the neglect of the technical institutions of the country to recognize and accept this duty.

"The regard for school education is not singular with the American people but it has been singularly universal with them, and a comprehensive educational system has resulted which reaches even to the remote byways of the country. An educational system which meets the needs of the country, however, must be something more than a mere comprehensive school system in touch with the people. It must not only offer education in general, but it must also offer those special educations which are necessary for the fullest development of each branch of human endeavor and service. In

satisfaction of this condition, the great variety of professional schools have been established,—divinity schools, law schools, medical schools, schools for the professional engineer,—and on the other hand, trade schools of various characters. In the latter respect, however, this nation has been at fault. Some trades schools have been established and maintained, and manual training has come to be highly regarded,—perhaps too highly regarded in the high schools though insufficiently established in the grade schools; but the development of trade schools has been insufficient to the country's needs, and foremen's schools are still almost unknown."

Lavish appropriations for educational purposes have been made by both Federal and State Governments and with excellent results, as evidenced by the work of the great State universities of many of the western states. But the demand for university-trained engineers has been so great that the activities of state colleges have been limited to professional engineering work. Agricultural education has also made large inroads on the public funds and agricultural schools have been developed out of all proportion to the needs of the agricultural section of the population as compared with those of the manufacturers. There is a widespread belief in the fallacy that the prosperity of the country depends upon its agricultural resources and the agricultural community has selfishly clamored for funds which should have been applied to industrial education.

"The engineering schools, like their friendly rivals, the agricultural schools, have before them a field which may be divided into three parts—a triple field—two parts being semi-professional or completely professional and the third vocational and subordinate to the others. The engineering schools have only occupied one effectively, though a few are now growing towards an occupation of a second.

"These three parts to which I refer are the divisions of the educational scheme of the nation in which fall: (a) Engineering research and the advanced professional instruction which is being given here and there to a few graduate students; (b) The engineering courses of study as they are now ordinarily planned; and (c) The instruction of artisans and especially instruction adequate to the needs of industrial foremen or sub-superintendents, that is, master craftsmen.

"The second of these educational divisions in the order here named, it seems to me the engineering schools are occupying very well, but even here there is a lack of effectiveness which seems due to lack of correlation between the schools and lack of study of pedagogic history by those persons responsible for the direction of the schools. Reasonable independence and individuality in methods of teaching is due to the individual men who are experienced and worthy in each school, and the individuality of the several schools must not and cannot be infringed; but unhappily in the past, there have been contrasts of pedagogic views and professional ideals that cannot be justified, for in these things (matters of judgment though they be) truth can lie only in one direction, however diverse may be the paths over which she may be approached.

"It is to the third educational sub-division that comes distinctly within the purview of the influence and direction of the engineering schools though preferably not within the scope of their curriculums that I direct your attention. This is the instruction for artisans, and particularly the instruction intended for foremen and sub-superintendents. . . . The secondary industrial schools of the country are utterly without adequacy in numbers or extent to meet this problem in secondary education; and the schools suitably planned for the appropriate education and improvement of foremen are almost unknown with us.

"I lay this latter fact at the door of the engineering schools, and hold that the members of the faculties are not guiltless unless they make adequate efforts to get filled this need in education for master craftsmanship in the industries, which comes within the purview of their influence and direction.

"The governing boards of the engineering schools must divide the guilt with the faculties, if they continue their common failure to provide sufficient teaching force in the engineering departments, thus putting any effort which reaches beyond the routine of the department curriculum and

touches the larger interests of the industrial body beyond the physical endurance of the individual members of the faculties.

"Governing bodies have also been at fault heretofore by too close adherence to a standard for engineering teachers in which mere ability to impart information in the class room, without consideration of any breadth of ambition, has held too predominant a place in the selection of men, and breadth of view in industrial affairs accompanied by clearness of judgment has had too small a place. I do not undervalue the technical ability to impart information in the class room, and assent that this should be properly given much weight in selecting men for the engineering faculties; but this ability, however largely developed and however fully accompanied by engineering skill is far from sufficient to make an adequate member of an engineering faculty.

"The acts of many governing bodies heretofore are in some degree excusable in consideration of the breathless growth of engineering schools which has seemed to make impracticable any pause for thought or consideration of needs beyond those of the day's pressing want of active teachers and suitable appliances to give strength to their teaching. It seems to me less excusable that so large a proportion of the leading men in the engineering schools should neglect on their own part a due consideration and study of pedagogic history and the development of the lines of philosophy and sound pedagogic thought, which lead inevitably to broader sympathies and more comprehensive professional views. An engineer who has cultivated a correct professional spirit ought to recognize promptly and appreciate fully the importance of careful study of professional precedents of the best types, and if the engineer is also a teacher, he seems to be under obligation to take a comprehensive view of both sides of his vocation, the side of engineering and the side of education.

"I believe that such views lead emphatically to the proposition that engineering schools are called upon to extend their influence so that they will continue their present work of education for the scientific engineer; advance the work of engineering research and advanced professional study; and also foster the establishment, maintenance and development of polytechnic schools for master craftsmen. . . . Such schools supported by endowments or by the state could wisely be founded in each large industrial center, but in each instance the school government needs the combined interest, activity and support of the better manufacturers and of suitable members of the faculty of a great engineering school. It must always be borne in mind that these schools should equally assist the craftsmen and the industries employing them, and thereby improve the fitness and promote the prosperity of the state."

Besides the selfishness of the agricultural class mentioned above, two other causes militate against the development of industrial education. The first of these is the opposition of trade unions to the spread of education calculated to develop the special capabilities of each man and accentuate the differences between the abilities and earning power of individuals. This form of opposition is however gradually decreasing among the more influential labor organizations and may be expected to die out in time. The second cause lies in the fact that the men who have made fortunes through manufacturing industries and transportation rarely give of their riches to advance the condition of the industries through association with which they have come to wealth, preferring to found art galleries and museums, rather than industrial schools. "While asserting that I fully appreciate the fine influence of art galleries and museums, I also insist that at the present juncture of education in this nation any man with a fortune to bestow can do a more pervading good by aiding the engineering schools to develop the work of engineering research, and by establishing schools for industrial foremen to be directed with the assistance and advice of the engineering schools.

"Our communities maintain manual training schools and here and there a trades school, and great professional engineering schools are maintained in the east by private endowments and in the great states of the west by appropriations from the state governments; but there still remains a gap in industrial education which lies between the elementary trades schools and the professional engineering schools of university

grade. This gap must be filled and it will be filled promptly if the men who are and who ought to be members of this society do their duty. It is imperative to give to the thousands of young men who are to make the bulk of the corporals and sergeants of industry that education which makes for self-support in the best sense, makes for proper parentage, and makes for a good grade of thoughtful citizenship (to which foremen's schools may be directed in keen fashion) before the education which lends figure and charm to a man's recreations (such as so fortunately comes from the art galleries and museums) is taken up. I believe that no use of money can bring greater returns to the state, or greater satisfaction to the giver who understands the educational situation, than large gifts for the purposes of industrial education."

## BREATHING APPARATUS FOR USE IN MINES.

EXTRACTS FROM THE REPORT OF THE ROYAL COMMISSION ON MINES DEALING WITH THE DEVELOPMENT AND APPLICATIONS OF BREATHING APPLIANCES.

*Report of the Royal Commission on Mines.*

THE first report of the Royal Commission on Mines, recently published, deals with only one element of the inquiry outlined for them by the Home Office. Very few sittings of the Commission had been held before it was decided that confusion and delay might result from taking testimony simultaneously on all questions bearing on the problem of safety in mines, and therefore within the scope of the inquiry. Hence, for the greater part of the past year, the Commission have given their exclusive attention to the questions of the compulsory watering of roads in dry and dusty mines, and the provision and use of breathing appliances as a means of facilitating the work of rescue in the event of an accident. The report just published deals with the latter of these two questions and presents a very clear discussion of the history and present development of breathing appliances and of their applications.

Several of the leading types of apparatus were tested under the direction of the Commission, most of the tests, however, being made in the laboratory. The desire of the Commission was not to obtain exhaustive data as to the practical working of the various appliances, but merely to show how far their functioning complied with the requirements of the human subject under different conditions. The tests and results are described at length in an appendix to the report. The following abstracts give only the general conclusions arrived at by the Commission.

"The results of the experiments are in our opinion satisfactory, and show that the existing appliances have been greatly improved as compared with the earlier types. The report, however, shows that there are defects, some of a trivial and others of a more serious character, in each apparatus, and in drawing attention to these defects the Commission hope that the criticisms passed will lead to improvements being made. The appliances generally give indication of steady development, largely as a result of practical experience, and the Commission feel that they cannot lay too much stress on the need for further experimental trial under suitable conditions.

"After fully considering the results of experience here and abroad, we are of opinion that the question is ripe for further development in this country, and demands the serious attention of the industry. We have considered whether it would be desirable to make the provision of any of these appliances compulsory, and we have come to the conclusion that sufficient advance has not been made in this country to justify such a course at present. A good deal of experience is required both as to their working and the best system of training men before their use can be properly appreciated. The readiness of mine owners in the United Kingdom to adopt any precautions which may lead to the diminution of the risks of mining is well recognized, and we feel confident that the necessary steps towards a systematic use of the appliances will be taken by them without delay.

"We make no recommendations as to the

use of any particular appliance. The various types are steadily developing and it is desirable that further trials should be made. Ultimately, when more experience has been gained, there would be obvious advantages in securing the use of a uniform type in the same district.

"We do not wish to convey any false impression by suggestion that the provision and use of breathing appliances is likely to lead to any considerable decrease in the number of lives lost by explosions. Exaggerated expectations of their utility in saving life in mines have arisen in some quarters. On the other hand, many practical mining engineers have, we think, too hastily formed the opinion that in face of all the real difficulties in rescue work, and the element of risk involved in their use, breathing appliances are not likely to be of any real service. We desire, therefore, briefly to indicate the circumstances under which they may prove useful, if proper training and efficient organization are secured.

"Apart from actual rescue work, breathing appliances may be of great service in making it possible to deal with underground fires more safely and effectively than would otherwise be the case. In the event of a gob-fire, for instance, the seat of the fire may, on account of smoke, be inaccessible without great risk, and in such a case breathing appliances could obviously be used with much advantage in exploring and directly attacking the seat of the fire, in building stoppings close up to it, and in preventing the poisonous fumes from menacing the safety of men beyond. Breathing appliances, including smoke helmets supplied with fresh air through a pipe, are now frequently used for this purpose in Westphalian and Austrian collieries, where gob-fires are not uncommon. In a report on a recent visit to the Westphalian coalfield it is pointed out that 'the pecuniary advantages resulting from the use of apparatus for penetrating irrespirable atmospheres and water has had quite as much to do with their general adoption in Westphalian mines as the desire to have the means at hand for saving life.' Some British collieries are seldom free from gob-fires or dangerous heating; these fires often cause not only danger to life but great loss of property to coal-owners, and loss of employment to men. Hence, there seems to be a considerable field for the use of breathing apparatus apart altogether from rescue work after explosions.

"In the event of an explosion anything which facilitates the rapidity and safety with which the ventilation can be restored and the after-damp removed must contribute towards the saving of life. Most of the deaths are caused by after-damp, and men are frequently alive for a considerable time after the explosion has occurred. Delay is often caused by uncertainty as to whether fires exist, or the impossibility of dealing with them if they are present, or else by difficulty in getting through airways in order to restore the ventilation. The use of breathing appliances may obviate some of this delay, and facilitate in various ways the work of exploring the mine, in rescuing any man found alive or any explorer affected by after-damp, and in 'recovering' the mine itself. We do not think that breathing appliances can play more than a subsidiary part in rescue operations after an explosion, but this part may sometimes be of considerable importance.

"Against the advantages to be obtained from breathing appliances, we must unfortunately place the risk attending their use. Accidents have occasionally occurred, owing to the apparatus being placed in inexperienced hands, or to failure to observe the necessary precautions. The regrettable accident at Courrières by which an untrained man lost his life while wearing one of the appliances, will be borne in mind in this connection. On the other hand, there are probably still greater risks in rescue operations conducted without special appliances, and it is to the honour of the mining community that these risks are willingly taken whenever there is a reasonable probability of saving life.

"We think, however, that the risks attaching to the use of the appliances can be reduced to a minimum by a proper system of training, and we desire to lay particular emphasis on this point. In the first place, it is important for purposes of training to select men who are most suited for special work of this kind on the ground of general intelligence, physique, and temperament. The men selected should then be

given a thorough knowledge of the construction and working of the appliances, and should be accustomed by degrees to wearing them, at first in an experimental gallery and afterwards, when they have attained proficiency, in actual operations underground. Constant exercises at regular intervals under the supervision of a properly qualified instructor are essential.

"The best method of providing for the necessary training and practice is undoubtedly by the establishment of 'Central Rescue Stations.' This system, which consists in the establishment of a single station at a central point for the joint use of several neighboring collieries or a group of collieries, secures obvious advantages which will appeal to mine owners on the score of efficiency and economy. The value of this system has been recognized for some time in this country by the establishment of the rescue station at Tankersley. The same system was recommended in the reports made by the Committees of the South Yorkshire Coal Miners' Association and the Fife and Clackmannan Coalowners' Association, and it is understood that a similar recommendation has been made, and is being acted upon, by the Lancashire Coalowners' Association.

"The number of collieries included in a group for the establishment of a rescue station, and the method of organization, will depend largely on circumstances. One of the most important points for consideration is the need for having the appliances readily accessible in the event of a fire or an explosion, and the possibility of summoning, without delay, a sufficient number of trained men. In cases where the collieries are situated near to one another and there are facilities for bringing the appliances quickly to the spot, it may be arranged not only for the men to be trained at the station, but for the appliances to be stored there. In other cases, where the distances between the collieries are greater, and the means of communication are inadequate, such an arrangement might be found to be unworkable without the risk of serious delay in bringing the appliances to the scene of an accident. In such cases it might be better to arrange that each colliery belonging to the group should make separate provision for the storage and maintenance of a certain number of appliances in a suitable place at the surface, and that additional sets should be kept at the central station. Whichever system is adopted, it is manifestly necessary that the appliances should be placed in the charge of a thoroughly competent person, and should be constantly examined and cleaned and kept ready for immediate use.

"The rescue station will not only form the most suitable place for instruction and practice, but will become, under a proper system of organisation, a center from which men trained in the use of breathing appliances can be quickly obtained when the necessity arises. It may be anticipated that for some time it will not be possible to train more than a small proportion of the men employed at a colliery, and cases may arise in which outside assistance is required. It could be arranged by a system of co-operation between mines attached to the same station that the men trained there should, in cases of emergency, be available for service at other than their own collieries. The names of the men best suited for such service could be recorded by the officer in charge of the rescue station, and on the receipt of a message from a colliery that help was required, a well-trained and well-equipped corps could be sent without undue delay to assist the men belonging to that particular colliery."

## NEW IMPROVEMENTS IN ARC LAMPS.

THE DEVELOPMENT AND ADVANTAGES OF THE MAGNETITE-ELECTRODE LAMP.

*G. M. Little—National Electric Light Association.*

DURING the last few years the development of electric lighting has been mainly along the lines of improvement of the incandescent lamp, the arc lamp having received comparatively little attention. Recently, however, some important improvements, leading to greater efficiency and economy, have been made in the latter, one of the most prominent of these being the development of the magnetite-electrode lamp. The following abstract of a paper by Mr. G. M. Little, pre-

sented before the National Electric Light Association, describes the advantages of these metallic-oxide electrodes and the development of a lamp suitable for using them.

"The magnetite electrodes were so named because magnetite is usually one of the constituents of the negative or cathode, but it would be more satisfactory to call them metallic-oxide electrodes, as, in addition to the magnetite, there are always at least two other oxides present—namely, oxide of titanium and oxide of chromium.

"These electrodes are made in a very different manner from the carbon electrodes. As is well known, the latter are squirted or moulded from a plastic mixture, and are baked, the carbon furnishing sufficient mechanical strength and electrical conductivity. A metallic-oxide electrode cannot be made this way, for it is a familiar fact that a fine powder is a poor conductor, no matter of what it is composed, and as these electrodes are made for the most part from finely powdered oxides it is evident that a conducting binder or a conducting case would have to be used. In practice, the mixture of oxides is tamped into a thin iron tube and the end sealed in an arc.

"The oxides have distinct and separate reasons for their presence. The titanium oxide has the property of rendering the arc luminous, and it may be here noted that the metallic-oxide arc is a flame arc, the light not coming from a crater as with carbons. The oxide of iron gives conductivity to the fused mixture when cold, the other oxides being conductors only when hot. The oxide of chromium prevents a too rapid consumption, so that by its use an electrode may be given a very long life.

"The positive, or anode, used with these metallic-oxide negatives is generally a metal, copper and copper alloys being used extensively, and is consumed much more slowly than the negative. This is contrary to what would be expected, judging by the action of the carbon electrodes.

"There are a number of advantages possessed by the metallic arc over the carbon arc. In the first place, the efficiency is much better; that is, a metallic arc lamp operating on a 4-ampere current with approximately 65 to 70 volts at the arc will give a light equal or superior to that of a 6.6 ampere, 75 volt, direct current, enclosed carbon arc lamp.

"The distribution of light is far better. This is owing to the fact that in the enclosed carbon arc practically all the light comes from the crater on the flat under-surface of the upper electrode, most of it being thrown down and not serving to illuminate the street between lamps. The light from the carbon arc itself is weak and of a blue colour. This is very pronounced at times, especially if the flat under-surface of the upper electrode is somewhat inclined, thus hiding the crater. In the case of the metallic-oxide electrodes, the arc is itself the source of light, practically none coming from the crater, except by reflection. The metallic arc is much like a candle flame, having its luminous and non-luminous zones. The light is brightest near that end of the arc which is next to the negative electrode, and comes from a hollow cone-shaped mantle of volatilised oxide of titanium rendered incandescent by the heat of the arc, just as in the candle flame the light comes from a hollow cone-shaped mantle of carbon particles made white hot by the heat of the flame.

"The voltage required to maintain a metallic arc is less than that of an enclosed carbon arc. It is a familiar fact that an enclosed carbon lamp will not burn properly with the arc voltage down to 65, while a metallic arc will burn well at less than 55. Metallic arcs are adjusted to burn at from 65 to 75 volts in different cases, while the carbon arcs are all set at 80. This is a very evident advantage in favour of the metallic arc, as more lamps may be put on a circuit without raising the voltage on the line.

"The life of carbon electrodes, as a rule, is not over 150 hours, while the metallic-oxide electrodes can go considerably longer.

"The uniform white colour of the metallic arc is in marked contrast to the changeable blue and white of the enclosed carbon arc.

"As the metallic-oxide electrodes are not burned 'enclosed' there is no inner globe required on the lamp."

The securing of all these advantages was not an easy matter. In the first experiments the electrodes were arranged as in

the carbon lamp, that is, with the positive above and the negative, the metallic-oxide electrode, below. Several difficulties presented themselves. From the point of view of illumination the arrangement was not a success because first, a large shadow was formed on account of the bright portion of the arc being near the surface of the lower electrode; second, the fused slag on the lower electrode reflected a great deal of light upward; third, a reddish soot which obscured the light formed in spongy masses around the electrodes; and lastly, an unsteady arc was formed, due to the negative electrode burning to a blunt taper point. Mechanical difficulties were also apparent, the most important being that only a short metallic-oxide electrode could be used, and that, as the negative electrode was the more rapidly consumed, an under-feed mechanism was necessary. Hence it was found necessary to reverse the positions of the electrodes.

"The first attempt to burn the metallic-oxide electrode above and the metallic electrode below showed that there were serious obstacles to be overcome before it could become a practical method. In the first place, the electrode would not keep a square end, but would waste away on one side, and the arc would run up this bevel or slope, giving a very unsteady light. In the second place, the volatilized oxides of iron, chromium, titanium, etc., would condense on the sides of the electrodes and hang down as a fringe or curtain, hiding the light.

"The first means taken to overcome these troubles was the introduction of a rotating draft of air around the arc. This had the effect of forcing the arc to hold to a central position, stopped the crooked burning and steadied the light, but did not take care of the fumes. Attempts to blow the fumes away sideways gave only partial success. Finally, a current of air was directed down around the arc, and this gave excellent results. The electrode burned perfectly square, and the clean layer of air prevented any gathering of fumes. This was a very marked advance, as it did away with any need for a mechanical scraper or shaker, the soot practically all passing out of the chimney and not requiring to be caught in any receptacle, the globe remaining clean. . . . . .

"The special conditions described with regard to draughts are obtained by a down-draught tube, which directs the current of air down around the electrodes, another current of air over the reflector and circling around the globe forming a means of protection to them, and a special construction of top and case for giving proper draught conditions when under all conditions of wind."

## AMERICAN RAILWAY SECURITIES.

A FOREIGN ESTIMATE OF THE ECONOMIC CONDITION OF AMERICAN RAILWAYS AND THE CAUSES OF THE RECENT DECLINE IN THE VALUE OF SECURITIES.

*G. M. Boissevain—Revue Economique Internationale.*

PROBABLY no question in the United States is of such wide importance or touches so many interests as the present railway situation. From the traveling public the prevalence of wrecks and derailments raises a periodical storm of protest against alleged faults and negligence in management. Shippers are hampered by the shortage of rolling stock and the consequent delays in freight movement. Politicians in all sections of the country, reflecting the popular outcry against all classes of corporations, are agitating for a more or less radical degree of government control and regulation. These and other phases of the situation have been dealt with in former issues of THE ENGINEERING MAGAZINE. In the present number Mr. Gaines' article presents one of the economic problems, the physical valuation of railway properties. The following abstract of an article by M. Boissevain in a recent number of the *Revue Economique Internationale* discusses another question of economic interest, the recent decline in value of American railway securities.

In general the year 1906 was one of enhancement of values. Abundant crops, increased activity in the metal trades, and an enormous development of commerce gave to all sections of the country an exceptional degree of prosperity. The rail-

ways were overwhelmed with traffic and the receipts reached a point never approached before. Gradually, however, the tightness of money was beginning to make itself felt. More than once during the summer the marketing of securities suffered from this cause and there was some apprehension as to the result of the usual large demands of money for crop movements. At the same time it was clear that the public was not buying securities on the stock market. This reluctance was, however, considered as only temporary and had no effect on the optimism of professional traders, to whom the future presented nothing but increasing prosperity.

This optimism in Wall Street was greatly increased in August, when the semi-annual dividend of the Union Pacific was increased from 3 to 5 per cent., and the Southern Pacific announced its first dividend at the rate of 2½ per cent. semi-annually. These dividend declarations gave a still greater impetus to the bull movement. It was confidently predicted that other roads would soon follow the example set by these two, in declaring new and increasing old dividends; it was necessary only to hold out until the beginning of the year, when with the usual relaxation in the tightness of the money market there would be a rush of buyers for railway securities and a consequent profit to the traders. In fact, though the tightness of money increased rather than diminished, stocks were held fairly close to the high levels of the year during the last few months of 1906 and even experienced a slight advance after the new year. But, contrary to the expectations of the professional traders, the public still remained out of the market, and in March the bull market collapsed with a crash which carried the prices of railway securities in general much below the low levels of 1906. Subsequent movements have not enabled them to recover to their normal levels.

The first cause of this great depreciation in the value of railway securities was the fact that the prices to which stocks were forced before the crash had no foundation on the intrinsic value of the securities, but were merely the result of professional manipulation in the stock market. These fictitious values the holders of capital refused to consider as normal, and they were not supported by purchases of new issues of securities. The optimists felt that though the prices were too high on the basis of the last dividends just at the time, the great development of industry and commerce would soon place them on a sound basis with higher and rapidly increasing dividends. But this reasoning was absolutely fallacious. The position of the railroads was such as to make the expectation of increased dividends absolutely unjustifiable, because the need of new capital was being recognized more and more strongly, and it was not forthcoming. In order to obtain purchasers for new issues of bonds the railroads had to dispose of them at a sacrifice, and this showed that there was a tendency to hold out for greater investment returns, a fact which in itself made the lowering of the price of stocks imperative.

The expectation and prediction of a general increase in dividends was based on the great development of traffic with which the railroads were overwhelmed. But though increased traffic caused large increases in the gross receipts, the operating costs were increasing at an equally rapid rate. This was due to two causes, first, the large increase in the cost of labor and material of all kinds, and second, the fact that the railroads were not equipped to handle the enormous traffic and needed large amounts of money for new rolling stock and for extensions to lines and yards. Each month during 1906 the gross receipts of the larger lines as compared with the same month the year before showed a substantial increase, but the corresponding increases in the net receipts constantly grew smaller and smaller, until in the month of January, 1907, the net receipts showed a decline from those of January, 1906, notwithstanding a considerable augmentation of the gross receipts. The increases in gross receipts were being more and more absorbed by increases in operating costs and, in some cases, in fixed charges.

Here then was one cause which precluded the possibility of higher dividends. The other, paradoxical as it may seem, was the direct result of the increasing traffic. The general production of the United States has made enormous strides within recent years, and this growth was reflected in the rail-

road earnings. From 1895 to 1905 the total receipts of the railroads of the country increased from 1075 millions to 2082 millions, but in the same period the capitalization of the railroads increased only from $10,346,754,229 to $13,805,258,121. During this period the policy of the railroads, in coping with the annually increasing volume of business, was, generally, to make as few extensions to lines, and as few increases in capital, as possible. They devoted all their energies to improving existing lines, by reducing grades, replacing light with heavy rails, reconstructing bridges, etc. Rolling stock also had to be adapted to the new conditions, and old locomotives and cars had to be replaced by new ones of more modern design. As a consequence of these improvements in permanent way and equipment, large deductions had to be made from the receipts in lieu of making new loans. In a word, the railroads did everything possible to use their lines and equipment up to the extreme limit while extending their capital as little as possible.

At last, however, when this policy would no longer serve, when the railroads despite their best efforts found themselves overwhelmed with traffic, it became necessary to undertake the building of new lines, extraordinary improvement work, double tracking on trunk lines, extensions to stations and yards, and large additions to rolling stock. This could be done only at enormous expense, and when the financial world finally realized the magnitude of the works necessary to carry this new policy to a successful conclusion, there resulted a general panic. And, in fact, it was justified. Mr. Hill, one of the foremost authorities on railway affairs, has calculated that to place all the railroads of the United States in good condition would require an annual expenditure of at least a billion dollars for the next five years.

When the railroads finally awoke to the necessity for changing their policy there was a general rush for new capital. During the last few months of 1906 several companies began to issue new stock and to negotiate loans, and since that time new issues of securities have not ceased. According to some apparently credible calculations, the total of the new issues during the last half of 1906 was about 400 million dollars, and the new issues announced since the first of the present year reached the enormous total of one billion dollars, 600 millions of which have already been put on the market. The impossibility for the market to absorb these enormous issues was the great cause of the decline in the prices of railroad securities.

A final cause of the decreased values is to be found in the governmental and popular agitations against the railroads. This had its origin in an attempt to remedy some abuses of power on the part of the officials of some of the roads, but has developed into a general attack with the final object of bringing the railroads under government ownership. This is having a temporary effect on railroad securities, but there seems to be little to cause alarm as to the ultimate outcome. It can safely be left to the good sense of the American people to give the railroads, which have been so largely instrumental in the building up of the country, full opportunity for further development without unfair limitations.

## THE DEVELOPMENT OF THE MOTOR BOAT.

EXAMPLES OF MOTOR BOATS OF VARIOUS TYPES RECENTLY INTRODUCED IN EUROPEAN NAVIES.

*W. Kaemmerer—Zeitschrift des Vereines Deutscher Ingenieure.*

THE rapid development of the motor boat during the past few years has been one of the direct results of the enormous growth of the automobile industry, which has given an impetus to so many allied interests. Motor-boat building can as yet scarcely be called a separate industry, but that it is rapidly attaining that position is evidenced by the large number of firms who are interesting themselves in its development and by the attention which is being paid by engineers to the problems connected with the application of the internal-combustion engine to marine propulsion. An interesting sketch of the development and present status of the motor boat was recently given by W. Kaemmerer before the *Verein Deutscher Ingenieure*, of which the following is an abstract.

When one considers the share of the

various countries in the development of the motor boat, the industry is seen to be a direct result of the development of the automobile, for France has taken first place in motor-boat building also. This applies, of course, less to boats for commercial and general use than to racing craft, in which department French builders have been unusually successful. That racing trials, for which such boats were primarily built, have an important technical value aside from their sporting interest is easily seen from the progress of French motor-boat building, which certainly would not have attained its present status if the stimulus of the racing fever had been lacking. One of the most important results which must be attributed directly to the prevalence of the sport in France was the gradual lessening of the weight of the motor. Some of the results obtained in this direction were quite wonderful, the Société Antoinette, for instance, producing a motor which had the almost incredibly small weight of 1 to 1.5 kilograms per horse power and was, at the same time, an efficient and safe machine. To the influence of racing must also be attributed a great deal of the development of the motor boat in Italy, where it has attained a high degree of perfection. All the principal firms connected with the industry produce the boat complete and on that account have attained excellent construction. In England, Germany and the United States motor-boat building seems to have been taken up more on the practical and commercial side, and, although some firms in each country make a specialty of racing craft, by far the larger number of boats built are designed for commercial and general service. The United States leads in the number of firms which produce motor boats as a part of their regular output and many of them are attempting to build up a large export trade by the establishment of branch houses in Europe.

The applications which may be made of the motor boat are very numerous, but, aside from pleasure craft, the greatest interest has been paid to its applications in the navy and its associated interests. The Italian navy has been especially active in this regard though the navy departments of other nations have not been far behind. That the motor boat has not had a more rapid and general development is due to the peculiarities of the internal-combustion engine in its present condition. Of these high speed and low efficiency of screws and the difficulties of reversing and speed regulation have been the most important factors in retarding development. The difficulty of speed regulation is a great drawback in heavy weather: to maintain a high speed in a small boat on a heavy sea results in filling the boat so full of water that it must either capsize or sink. The question of fuel is still unsettled. The use of benzine is attended with great risk of fire unless great caution is used. Recently the effort has been made to substitute petroleum or other heavy oils for the commonly used benzine. The general introduction of these oils would greatly reduce the risk of explosions and also operating costs, but would necessitate alterations in the design of motors.

The British navy seems to have in view the application of internal-combustion motors to larger vessels, which, unlike the auxiliary boats of the larger ships of the squadrons, are designed to constitute a distinct fighting unit. These are what are known as motor torpedo boats. The first representative of this class was brought out by Yarrow and Co. in 1906. The vessel is 18.28 metres long and 2.74 metres beam and the draught is from 0.3 to 1 metre. Tried without load it reached a speed of 25.5 knots, and, with a 3-ton load, 24 knots. The boat was propelled by three benzine motors of a total of 300 horse power, working three shafts at a speed of 1000 revolutions per minute. The outer machines have eight cylinders, and the middle motor, four. The former can be used only for going ahead, but by means of a reversing gear the boat can be run astern on the middle motor.

The general introduction of this type of torpedo boat would get back to the original design in the introduction of the torpedo arm into naval service. This was to put in service large fleets of small but very swift boats, offering the smallest possible target area and armed only with torpedoes, which were to attack hostile ships in great numbers. But the size of torpedo boats has steadily increased until now they re-

semble small cruisers and are rarely under 50 meters long and of a displacement of 500 tons. It is doubtful that these large boats are any more effective than smaller ones would be.

For use in war the small cost of the Yarrow model is a strong point in its favor. For the cost of the "Dreadnought" about 350 torpedo vessels of this class could be put in service. The great advantage of the motor torpedo boat is its small weight of only eight tons. It is therefore possible to transport it by rail, an advantage which might be of the utmost importance in time of war in providing a harbor, attacked from the sea, with new and important means of defense.

In 1905 ten motor torpedo boats were built in America for the Russian navy, after designs by Mr. Lewis Nixon. These were somewhat larger than the Yarrow model, but still light enough for transportation by rail. On the other hand their speed, of 20 knots, was considerably smaller than that of the former model, but in their design the highest possible speed was not the prime consideration. These boats are 27.43 metres long, 3.35 metres wide, and draw 1.2 metres of water with a load of 34 tons. The weight of motors and fuel amounts to 15.5 tons, and with this amount of fuel they have a sphere of action at full speed of 400 knots. The small American torpedo boats on the other hand built for similar speed have a displacement of 51 tons and a sphere of action of from 100 to 160 knots. The Nixon boats are propelled by two six-cylinder benzine motors working on two shafts and reversed by means of compressed air. The armament consists of a deck torpedo tube for torpedos of 450 millimetres diameter, a 4.7 centimetre quick-firing gun and several machine guns. These boats are very seaworthy, as was shown by a voyage made by one of them under its own power from New York to the Black Sea during fairly rough weather.

A boat similar in construction to the Yarrow model but somewhat smaller has been built by Fiat-Muggiano for the Italian navy. It was designed as a torpedo-armed auxiliary for warships, but may be applied to similar service as the British boat, though its speed is only 15 knots. This vessel is 13 metres long and 3 metres wide. It is propelled by two benzine motors of a combined power of 200 horse power, working on the same shaft and started and reversed by compressed air. The total weight of the vessel, including machinery, is 7 tons. Fuel for an 180-knot voyage can be carried in tanks arranged forward and at the sides. The armament consists of two 356 millimetre torpedo tubes, a 4.7 centimetre quick-firing gun and two machine guns. A later boat built by the same firm was 11 metres long and had a displacement of 5 tons. It was driven by two 60 horse power motors on the same shaft and reached a speed of 17 knots. For tenders the Italian navy uses motor boats almost exclusively. The vessels built for this purpose by Fiat-Muggiano are 8.5 metres long, 2.35 metres wide and 0.58 metres draught. The displacement with a crew of sixteen men and 200 kilogrammes of fuel is 3.2 tons. For the service for which these boats are designed an average speed of 8.5 knots is sufficient and this can be maintained by a 20 horse power motor. At this speed enough fuel for a 24-hour run can be carried.

Although the German navy has as yet built no motor torpedo boats, several vessels propelled by internal-combustion engines have been placed in various services and the question of their general introduction is being considered. In 1903 the Daimler Company built a small vessel for general service in the torpedo department of the Kiel navy yard. This boat was propelled by an 8 horse power petroleum motor which was the first motor using this fuel to have electric ignition and to be started by benzine. Since that time many other boats have been built for use in the navy, nearly all of them using petroleum as fuel owing to the much higher price of benzine.

Probably the most important motor boat employed in the German navy was built by the Daimler Company for torpedo testing at Kiel and is used also for short voyages by the higher officers of the fleet. This boat is 17.7 metres long and 2.40 metres beam, and the immersion of the screw with 7 tons displacement is 1 metre. The metacentric height with 600 kilograms of fuel and a crew of six men is 450 millimetres. The boat is propelled by a 300 horse power,

six-cylinder motor which is located amidships. To the rear of the engine room is placed a fuel tank with a capacity of 750 litres. This amount of fuel is sufficient for a 6-hour voyage, but for longer trips other tanks can be carried easily. The fuel is ordinary lamp oil and the consumption is roughly 0.32 kilogram per horse power hour. The speed of the motor is from 800 to 900 revolutions per minute. In spite of the high power of the motor it is reversed by a hand-operated reversing clutch. The starting is also by hand, the fuel being drawn through the carbureter into the cylinder by a small hand pump. The average speed attained is 19 knots.

## ELECTRICAL TRANSMISSION GEARS ON MOTOR VEHICLES.

A SUMMARY OF THE TYPES OF ELECTRICAL TRANSMISSION USED ON HEAVY VEHICLES.

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THE following abstract of a paper presented before the Engineering Conference of the Institution of Civil Engineers gives an interesting summary of the systems of electrical transmission now used on motor vehicles, particularly those of the heavier types.

"In view of the somewhat barbarous method of gear-changing at present in vogue on most petrol-driven motor-vehicles, and of the fact that, crude as it is, this method continues to hold its own against all other mechanical devices, it is not surprising that attention has been turned to electrical arrangements for arriving at what is required, especially in the case of the heavier description of vehicles.

"Apart from the mere transmission of the motion of the engine crank-shaft, usually with a considerable reduction in the number of revolutions per minute, to the road-wheels, the chief requirements are: (1) an easily-operated and preferably automatic variability of gear ratio, so that full advantage may be taken of the maximum effort of which the engine is capable without over-running in obtaining the highest possible acceleration and speed for the vehicle under varying conditions of gradient, load, and surface and other resistances; (2) perfect control of the speed of the vehicle under different conditions beyond the variations of which the petrol-engine is capable; (3) ready disconnection of the engine from the road-wheels, so that the former can continue to run while the latter are at rest, coupled with means for gradual reconnection, so that the vehicle may start smoothly and without shock.

"Important considerations that have to be taken into account in comparing electrical and mechanical methods of arriving at the above requirements are: ease of working, reliability, and freedom from breakdown and derangement, weight, efficiency in terms of the power lost in the transmission, first cost, cost of upkeep, quietness, and freedom from vibration.

"Several arrangements of electrical transmission have been adopted, and, with varying details, may be described as follows:

"(1) The engine, which is preferably fitted with a governor, drives a dynamo which supplies energy to an electric motor, which in turn drives the road-wheels through the usual mechanical differential gear. An electrical controller of some description is fitted, so that the electric current can be so varied as to regulate the speed of the motor, while, either by means of the controller, or automatically by special windings on the dynamo and motor, the full power of the engine at its most efficient speed can be employed to generate constant watts made up of either a large current at low voltage, such as is required for starting and on steep gradients, or a small current at a higher voltage for running the vehicle at high speed on the level, with corresponding variations under intermediate conditions.

"(2) Similar to No. 1, excepting that the axes of the dynamo and motor being arranged in line, a clutch of some description is arranged between them, so that at top speed they can be mechanically connected together, and electrical driving and all consequent losses dispensed with, the armatures of dynamo and motor acting merely as fly-wheels. In this arrangement the electrical drive is only employed for starting, and at other times when the power of the engine is insufficient to propel the car on the direct drive.

"(3) The engine drives a dynamo, as in the previous cases, but instead of one motor, two or more are employed, each driving a separate wheel. The mechanical differential is thus dispensed with, but the direct drive, as in No. 2, cannot be arranged for. The two or more motors can either be arranged in the hubs of the wheels, when all gearing is dispensed with, or can drive the wheels through chain or toothed-wheel reduction gear. The latter are the arrangements usually employed, as unless some form of speed reduction is used, the motors are of necessity relatively very heavy. The employment of two or more motors enables the series-parallel system of control, so much used on electric tramcars and trains, to be adopted on motor vehicles.

"(4) A storage battery of comparatively small capacity, but capable of giving large discharges for short intervals, can be employed with any of the above-mentioned systems, the arrangement being such that for starting, or on hills, the battery discharges and assists the engine and dynamo in driving the motors, while at other times a part of the power of the engine is absorbed in charging the battery, the change being automatically effected by the relative voltage of the dynamo on the one hand, and of the battery on the other.

"(5) In another method, in which a storage battery is used to assist the engine when required, there are no separate dynamo and motors; but on the shaft of a mechanical transmission is fixed the armature of a machine which performs the functions of both dynamo and motor as required, automatically charging the battery when the engine has power to spare and the speed increases, and taking a discharge from the battery and acting as a motor, so as to assist the engine when the latter becomes overloaded and the speed diminishes.

"These systems with auxiliary batteries possess the advantage that, as the battery affords a ready means of starting the engine, the latter can always be stopped when the vehicle is at rest.

"Where storage batteries are employed, continuous currents are necessary, and, apart from this, most of the systems so far used have been on the continuous-current principle, which gives large changes in gear-ratio more readily. On the other hand, multi-phase alternating currents have already been employed with some measure of success, and are a matter of considerable interest, as with them commutators and brushes, and their attendant troubles and expense, are avoided, except in the case of the comparatively small exciter dynamo that is usually employed."

## AUDIBLE RAILWAY SIGNALS.

A DESCRIPTION OF THE MECHANISM AND ADVANTAGES OF A SYSTEM RECENTLY INSTALLED ON BRITISH RAILWAYS.

*W. Dawson—Institution of Civil Engineers.*

THE great difficulty in the use of visible railway signals, even when in perfect working order, has been their liability to obscurement during snowstorms or foggy weather, and the invisibility of signals has often been pleaded as an excuse for accidents occurring under such conditions. Various means have been tried to remedy this defect, among them being the use of special detonator fog signals and, more recently, artificial fog dispersion, but it has been found that absolute dependence could be placed in none of these systems. According to a paper presented by Mr. W. Dawson before the Engineering Conference of the Institution of Civil Engineers, however, the problem has been solved on one of the larger English lines by the installation of an audible system of signaling, which is apparently reliable under bad weather conditions and besides possesses several advantages for constant use over the visible type. The following full abstract of the paper describes the mechanism and outlines the advantages of the system.

"The outdoor visible signals on our railways have been found satisfactory when the atmosphere is clear, either by day or by night, but on the descent of a fog they need to be supplemented or replaced by something which is audible. It has been

felt by railway officers, and by the inspecting officers of the Board of Trade, that no device would meet the requirements of the situation unless it would give the driver of a train a distinct audible 'danger' signal, and a distinct audible 'all right' signal; further, that the device must not depend on electricity to give the 'danger' signal, and that should there by chance be any failure in the mechanism the result must be the sounding of the audible 'danger' signal.

"Such an apparatus has now been designed, and has been in use on the Great Western Railway on a short branch double line for fifteen months, supplementing the ordinary fixed outdoor visible signals as a first test; and as a more advanced experiment it has been in use for the past five months on a single line—22 miles long—in total substitution of the semaphore distant signals, which have been removed. During these experimental periods the apparatus has given great satisfaction, and the drivers and their officers have every confidence in it. The inspecting officers of the Board of Trade also have expressed their satisfaction with it, subject to the Great Western Railway Company reporting to the department at the end of six months' trial the result of the extended experiment.

"The main features and advantages of the system are as under:

"The parts consist of a slightly arched piece of timber, 40 ft. to 60 ft. long, bolted to the sleepers midway between the two running rails, on top of which is bolted a bar of T iron, suitably mounted and insulated, the bar being electrically connected by means of a length of telegraph wire to a switch at the signal-box. This bar is electrified by pulling a lever when it is desired to give the 'all right' signal. There is no moving part in this ground apparatus. This fixed, non-movable sloping bar also serves the purpose of lifting a rod connected with a mechanical device, fixed beneath the engine, of a standardised design to fit any engine. The lifting of this rod opens a small steam-whistle fixed in the cab of the engine when it is desired to give the 'danger' signal. To give the 'all right' signal, the action set up by the electrified bar on the ground apparatus restrains the whistle from blowing, but rings a bell. When the whistle or the bell sounds, either continues to do so until the driver shuts it off; and, without any further action on his part, it is ready to produce the same signal at the next station.

"Neither frost nor snow prevents the operation of the 'danger' signal. The system is applicable to both double and single lines, and works satisfactorily whichever end of the engine may be leading. The 'danger' signal will always be given should there by any chance be a failure of the electric action. Each signal being audible, it does not reduce the constancy of the driver's 'look-out' ahead. The arrangement will save all fogging expenses for those signalling posts at which it may be fixed.

"It operates during daylight, darkness, or foggy weather, and will bridge over the doubtful period between the time when a fog begins and the time when the fogman arrives at his post; and, even then, it is infinitely to be preferred to the fogman himself. It will avoid also the serious disorganisation to the train service, which now occurs even with the most approved detonator system of signalling. The detonator system of signalling, although the best hitherto devised, cannot claim for itself perfection, being subject to the possibilities of no explosion, or of the detonator being skidded off the rail. Even the fogman himself, without the knowledge of the man in the signal-box, may become disabled by accident, exposure, or indisposition.

"Seeing that the device is available at all times and in all states of the weather, it follows that fixed distant semaphores are not needed, and their cost, maintenance, and lighting need not be incurred. The Great Western Railway Company have removed them altogether on the single branch line already referred to.

"The use of the system may be extended, with the slight additional cost of the ground apparatus unelectrified, to give a 'danger' signal as a reminder to drivers to be prepared to run at the required speed over portions of the line where a reduced rate is ordered.

"The ground apparatus can be fixed at any desired distance from the home signal, in tunnels, on viaducts, and round curves in cuttings, and thus get rid of many difficulties which now beset railway officers in fixing a site suitable to ensure a driver getting a proper view of the signal."

The following pages form a descriptive index to the important articles of permanent value published currently in about two hundred of the leading engineering journals of the world—in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index note gives the following essential information about every publication:

(1) The title of each article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,

(7) *We supply the articles themselves, if desired.*

The Index is conveniently classified into the larger divisions of engineering science, to the end that the busy engineer, superintendent or works manager may quickly turn to what concerns himself and his special branches of work. By this means it is possible within a few minutes' time each month to learn promptly of every important article, published anywhere in the world, upon the subjects claiming one's special interest.

The full text of every article referred to in the Index, together with all illustrations, can usually be supplied by us. See the "Explanatory Note" at the end, where also the full title of the principal journals indexed are given.

**DIVISIONS OF THE ENGINEERING INDEX.**

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# CIVIL ENGINEERING

## BRIDGES.

**Aqueducts.**

Aqueduct Bridges on the Illinois and Mississippi Canal. Fred W. Honens. Illustrated description of aqueducts which carry this canal over the more important streams. There are nine in all, varying in length from 4 to 10 spans of 35 ft. each. 2000 w. Eng Rec—June 29, 1907. Serial. 1st part. No. 85324.

**Bascule.**

Bascule Bridge for the Corporation of Portsmouth. Illustrates and describes a bridge having two equal bascules, fitted with a complete electric equipment for raising them. 1000 w. Engng—July 5, 1907. No. 85592 A.

Rall Bascule Bridge Over the Illinois River at Peoria. A recently completed double-leaf bascule bridge of the Rall type is illustrated and described. 700 w. R R Gaz—July 5, 1907. No. 85467.

Some New Bascule Bridges. Brief illustrated descriptions of bridges of the

*We supply copies of these articles. See page 1007.*

Rall type and Scherzer type, at Peoria, Ill., and the Page type, at Chicago. 1800 w. Eng News—July 18, 1907. No. 85734.

**Blackfriars.**

The Widening of Blackfriars Bridge. Plan and description of this interesting engineering work now in progress in London. 1500 w. Engng—June 28, 1907. No. 85502 A.

**Double-Deck.**

The Bridge Over the River Wear at Sunderland. Illustrated description of interesting construction work in connection with the erection of this double-deck railway and road bridge. 2-page plate. 1600 w. Engng—July 12, 1907. No. 85870 A.

**Lift Span.**

New Lift Bridge Over the Buffalo River. Illustrated description of one of the largest lift span bridges ever built. 700 w. Ir Trd Rev—July 11, 1907. No. 85528.

**Manhattan.**

The Brooklyn Anchorage of the Manhattan Bridge. Contractor's Plant and Progress. Gustave Kaufman. An illustrated descriptive article. Discussion. 8500 w. No. 69. Pro Brooklyn Engrs' Club—1906. No. 85975 N.

**Piers.**

Methods and Cost of Constructing Six Crib Piers, Three Howe Truss Spans, and One Steel Draw Span. The present article deals with the construction of the piers, near the mouth of a river 19 ft. deep at extreme low tide, the top of the piers being 40 ft. above the river bed. 1800 w. Engng-Con—July 24, 1907. Serial. 1st part. No. 85902.

**Pontoon.**

A Floating Bridge with Arrangements for the Passage of Boats (Schwimmende Brücke mit Schiffsdurchlasz). R. Weyland. An illustrated description of a foot bridge over a canal at Stettin, Germany, one section of which can be drawn aside to allow boats to pass through. 3000 w. Zeitschr d Ver Deutscher Ing—June 29, 1907. No. 85682 D.

**Reinforced Concrete.**

The Reinforced-Concrete Railway Bridge Over the Rhone at Chippis (Eisenbahnbrücke in Armierten Beton über die Rhone bei Chippis.) Illustrates and describes the design and construction of this bridge in Switzerland. 3500 w. Serial. 2 parts. Schweiz Bau—June 22 and 29, 1907. No. 85638 each D.

**Removal.**

Removing a Historic Bridge. An illustrated account of the removal of 4-track swing bridge, near 175th St., New York City, carrying the tracks of the N. Y., N. H. & H. R. R., which is to be replaced by a 6-track Scherzer rolling lift bridge. 1500 w. Eng Rec—June 29, 1907. No. 85321.

**Steel.**

Renewing the 50-Metre Span Bridge at Kedoeng-Djattie on the Samarang-Vorstenlanden Railway (Vernieuwing der Vakwerkbrug van 50 M. dagwijdte te Kedoeng-Djattie in den Spoorweg Samarang-Vorstenlanden). Illustrates and describes the design and construction of this steel bridge in the East Indies. 4500 w. De Ingenieur—June 29, 1907. No. 85692 D.

**Viaducts.**

Brush Creek Viaduct on the Alabama Western-Birmingham Extension of the Illinois Central. Views, plan and description of a viaduct near Haleyville, consisting of 75-ft. deck plate girder spans, 9 towers with 40-ft. deck plate girder span and two 60-ft. deck plate girder approaches. 800 w. Ry Age—July 26, 1907. No. 85968.

The Moodna Creek Viaduct, Erie R. R. Plan and description of a viaduct designed for a double-track superstructure. 2500 w. Eng Rec—July 6, 1907. No. 85455.

## CONSTRUCTION.

**Coast Protection.**

Some Improvements on Galveston Island. F. E. Lister. An illustrated account of the sea-wall, and other protective works carried out, and the work of raising the grade, describing the novel and effective method of handling the filling material. 1500 w. Purdue Engng Rev—1907. No. 85929 N.

**Cofferdam.**

Difficult Cofferdam Work on Decomposed Rocks. Describes work at the foot of East 116th St. on the Harlem River, New York City, where troublesome conditions were overcome by simple expedients. 1200 w. Eng Rec—July 13, 1907. No. 85539.

**Columns.**

Heavy Columns in the Metropolitan Tower, New York. Describes the treatment in the design of the cross sections, details and connections of the principal columns for this structure which is to have a height of 668 ft. above the sidewalk. Ills. 1000 w. Eng Rec—July 13, 1907. No. 85540.

Earth Pressure of Column Foundations. (Der Bodendruck der Säulenfundamente). Adolf Francke. Mathematical discussion with diagrams. 5500 w. Oesterr Wochenschr f d Oeffent Bau—June 8, 1907. No. 85674 D.

**Concrete.**

Some Details of Concrete Construction. L. J. Hotchkiss. Illustrates and describes some of the methods used on recent work.

*We supply copies of these articles. See page 1007.*

7500 w. Jour W Soc of Engrs—June, 1907. No. 85724 D.

**Contractor's Plant.**

Rapid Blast Furnace Foundation Work. Charles M. Ripley. Illustrated detailed description of the contractor's plant for constructing the foundations for the 10 blast furnaces of a new steel plant at Aliquippa Park, Pa. 2500 w. Ir Age—July 25, 1907. No. 85878.

**Dams.**

The Dam with Subterranean Flood Sluices at Marklissa (Le Barrage avec Evacuateurs de Crues Souterrains de Marklissa). A. Dumas. A description of this dam on the Queis in Germany, at which the flood water is carried off through subterranean conduits. Ills. 6000 w. Génie Civil—June 15, 1907. No. 85616 D.

See also Civil Engineering, Water Supply.

**Failure.**

The Failure of a Reinforced-Concrete Building at Philadelphia. Illustrates and describes the failure, on July 9th, of a three-story and basement building in course of construction at 15th St. and Washington Ave., due probably to premature removal of supporting struts. 1200 w. Eng News—July 18, 1907. No. 85739.

**Gasholders.**

The Development of Gasholder Construction. George H. Cressler. Read before the Wisconsin Gas Assn. A review of the three main periods of development. 2000 w. Eng News—July 11, 1907. No. 85576.

**Levees.**

Gravel Spreader Used on the Colorado River Levee Construction. H. T. Cory. Illustrates and describes a simple, cheap and efficient spreader designed by Thomas J. Hind, describing the work it accomplished. 1200 w. Eng News—July 11, 1907. No. 85570.

**Reinforced Concrete.**

Early Reinforced Concrete in England. Reviews what was done in England in reinforced-concrete construction before the introduction of the French systems. 2500 w. Engng—June 21, 1907. No. 85397 A.

Reinforced-Concrete Building Construction. An informal discussion before the Boston Society of Civil Engineers. 19500 w. Jour Assn of Engng Soc's—June, 1907. No. 85896 C.

Use of Reinforced Concrete in Buildings. Frank C. Schmitz. Considers the design and application of this material to the erection of buildings, discussing foundations, columns, beams and girders, stairs, floors, and walls. Ills. Discussion. 9500 w. No. 66. Pro Brooklyn Engrs' Club—1906. No. 85972 N.

Report of the Joint Committee on Reinforced Concrete. Report adopted May 27, 1907, at the general meeting of the Royal Inst. of British Architects. Rules to be observed in construction. 8500 w. Jour Roy Inst of Brit Archts—June 15, 1907. No. 85499 B.

The New Customs House at Düsseldorf (Die Neuen Zollschuppen im Düsseldorfer Hafen). D. Geiss. Illustrated description of the design and construction of this two-story, reinforced-concrete building. 2000 w. Serial. 2 parts. Deutsche Bau—June 12 and 26, 1907. No. 85640 each D.

A Reinforced-Concrete Mill Building with Separately-Molded Members. An illustrated account of the construction of several reinforced-concrete buildings at the Edison cement works by casting the members and erecting them later. 2700 w. Eng News—July 4, 1907. No. 85472.

**Roads.**

The Supervision of Construction of the New York State Highways. Gives the methods of procedure as described by the State Engineering Department. 3500 w. Eng Rec—July 13, 1907. No. 85546.

**Sewers.**

See Civil Engineering, Municipal.

**Siphon.**

The Building of the Siphon of Suresnes (Notice sur l'Exécution des Travaux du Siphon de Surnesnes). M. Caldaguès. A description of the construction of this steel siphon, 340 metres long, a part of the Paris scheme for the purification of the waters of the Seine. Ills. 10000 w. Ann d Ponts et Chaussées—Part I, 1907. No. 85603 E + F.

**Steel Frame.**

The Construction of the Seligman Building, New York. Interesting work in connection with the erection of a 11-story, fireproof, steel frame building is illustrated and described. 2500 w. Eng Rec—July 13, 1907. No. 85545.

**Theatre.**

The Technical Details of the Albert Schumann Theatre in Frankfurt (Die Technischen Einrichtungen des Albert Schumann-Theaters in Frankfurt). Julius Weil. Gives details of the design and construction of this unique steel structure. Ills. 1500 w. Serial. 1st part. Elektrotech u Polytech Rundschau—June 5, 1907. No. 85646 D.

**Tunnel Lining.**

Cost of Lining a 4000-ft. Tunnel with Concrete and in Part with Brick. Gives itemized cost of lining a single-track railway tunnel. 1500 w. Engng-Con—July 17, 1907. No. 85769.

**Tunnels.**

An Official Examination of the Battery Tunnel, New York. Extracts from a recent report submitted by Nelson P. Lewis.

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2000 w. Eng Rec—July 13, 1907. No. 85538.

Completion of Grade Rectification in the Battery Tunnel, New York. Illustration with brief explanation of the work. 1200 w. Eng Rec—July 20,. 1907. No. 85795.

Progress of the Pennsylvania Tunnels Under Manhattan Island. Illustrates and describes changes made and the progress of this great engineering work. 2000 w. R R Gaz—July 12, 1907. No. 85516.

**Underpinning.**

A Problem in Underpinning. Discusses the underpinning employed at Mount Royal pumping station, Baltimore. Extracts from report of Richard C. Sandlass. 1200 w. Eng Rec—July 27, 1907. No. 85945.

**Warehouse.**

A Concrete Warehouse with Concrete Doors and Water Tank. Illustrated detailed description of a reinforced-concrete warehouse in Kansas City, Mo. 1800 w. Eng News—July 25, 1907. No. 85885.

## MATERIALS OF CONSTRUCTION.

**Cement.**

Simple Tests of Portland Cement. W. Purves Taylor. Gives simple tests that may be carried out by the small consumer. Tests for soundness, time of setting, purity, and strength. 1400 w. Engng-Con —July 17, 1907. No. 85770.

The Effect of Oil on Cement Mortar. R. C. Carpenter. Read before the Am. Soc. for Test Materials. A brief report of investigations. 400 w. Eng News—July 4, 1907. No. 85473.

**Concrete.**

The Wear of the Inter-Tidal Space On Concrete Marine Structures. Editorial discussing the possible disintegration of concrete under certain conditions. 1500 w. Eng News—July 18, 1907. No. 85738.

The Expansion of Concrete with or Without Reinforcement (Zur Frage der Dehnungsfähigkeit des Betons mit oder ohne Eiseneinlagen). C. Bach. A review of results and conclusions of elaborate tests on this subject. Ills. 5000 w. Zeitschr d Ver Deutscher Ing—June 29, 1907. No. 85683 D.

**Concrete Aggregates.**

Comparative Tests of Sandstone and Slags as Concrete Aggregates. H. J. Kesner and F. W. Doolittle. Thesis. Discusses the relative merits of the different aggregates found in Denver, Colo., and vicinity. 1200 w. Min Rept—July 4, 1907. Serial. 1st part. No. 85435.

**Corrosion.**

See Electrical Engineering, Electro Chemistry.

**Factor of Safety.**

Working Stresses and Working Factor of Safety in Structures. From Prof. A. N. Talbot's résumé of Tests of Concrete and Reinforced-Concrete Columns. 1500 w. Eng News—July 11, 1907. No. 85573.

**Floor Test.**

Standard Test for Fireproof Floor Construction. Reported by the committee on fireproofing materials of the Am. Soc. for Test. Materials. 600 w. Eng Rec—July 6, 1907. No. 85456.

**Gypsum.**

Gypsum Plaster and Gypsum Products as Building Materials. Marco Pedrotti. Trans. from *Der Gips und Seine Verwendung*. Deals with the principal artificial building materials made from gypsum, and the methods of using. 2800 w. Sci Am Sup—July 13, 1907. No. 85519.

**Reinforced Concrete.**

Carrying Capacity of Reinforced-Concrete Floor Construction. A. E. Lindall and G. R. Heckle. Gives a record of a test on a full-sized panel. Ills. 2500 w. Eng Rec—July 20, 1907. No. 85793.

Concrete T-Beam and Column Tests at the University of Illinois. Gives a résumé of the work done and an abstract of the conclusions arrived at by Prof. Talbot. 5000 w. Eng News—July 11, 1907. No. 85572.

The Tensile Strength of Concrete in Reinforced-Concrete Beams Subjected to Bending (Beitrag zur Frage des Rechnerischen Nachweises der Betonzugspannung für auf Biegung Beanspruchte Tragwerke in Betoneisen). Fritz Postewanschitz. Gives the results of tests on reinforced-concrete beams. 3000 w. Beton u Eisen—June, 1907. No. 85657 F.

Tests of Reinforced Concrete (Eine Eisenbetonstudie). M. G. Schinke and B. Löser. Gives methods and results of tests to determine the effect of transverse stresses on reinforced concrete. Ills. 1500 w. Serial. 1st part. Beton u Eisen—June, 1907. No. 85656 F.

**Reinforcement.**

Tests of Cold-Twisted Steel Rods for Concrete Reinforcement. Jesse J. Shuman. Read before the Am. Soc. for Test. Mat. Information to aid in determining the quality and relative merits of concrete bars. 1200 w. Eng News—July 15, 1907. No. 85736.

**Sand.**

Standard Sand for Cement Work. Information from an account of investigations made by M. J. Reinhart, to ascertain the properties of the best sand and how ordinary sands can be improved. 1200 w. Eng Rec—July 20, 1907. No. 85789.

**Slag.**

Disposal of Slag from Smelting Works. Herbert Lang. Illustrates and describes the use of slag for the construction of a

large breakwater at Santa Rosalia, Cal. 900 w. Eng & Min Jour—June 29, 1907. No. 85333.

**Specifications.**

The Enforcement of Specifications. Dr. Charles B. Dudley. Presidential address before the Am. Soc. for Test. Materials. Discusses materials, testing, sampling, etc. 8000 w. Eng Rec—June 29, 1907. No. 85320.

**Timber.**

Nomenclature and Specifications for Structural Timber. Gives the committee report presented to the Am. Soc. for Test. Materials. 1500 w. Eng Rec—June 29, 1907. No. 85325.

## MEASUREMENT.

**Azimuth.**

A New Method for Determining Azimuth. E. H. McAlister. Explains a method which possesses advantages on the score of simplicity, in cases where only a moderate degree of precision is sought. It requires no knowledge of the time or latitude. 3500 w. Eng News—July 25, 1907. No. 85889.

**Earthwork.**

Earthwork Reception in Egypt. Describes methods of swindling in the measurement of earthwork, dealing with various classes of work. 2800 w. Engr, Lond—June 21, 1907. No. 85402 A.

**Impact Test.**

A New Impact Test. L. W. Page. Read before the Am. Soc. for Test. Materials. Illustrates and describes a machine for such tests. The main object being to determine the relative toughness of road-building rocks. 1500 w. Eng Rec—July 6, 1907. No. 85459.

**Stream Discharge.**

A Method of Estimating Stream Discharge from a Limited Number of Gagings. J. C. Stevens. Describes a method extensively used in the Columbia River District. 1000 w. Eng News—July 18, 1907. No. 85732.

**Surveying.**

City Surveying in Its Relation to Judicial Functions and Actual Practice. I. Judicial Functions of the City Surveyor. Lewis T. Haney. II. Practice of City Surveyors in the City og New York. Richard L. Williams. Discussion. 6200 w. No. 70. Pro Brooklyn Engrs' Club—1906. No. 85976 N.

The Topographical Survey of Staten Island. Describes methods used in surveying this borough of New York City. 2500 w. Eng Rec—July 20, 1907. No. 85796.

**Terrestrial Magnetism.**

Recent Results of Terrestrial Magnetic Observations. L. A. Bauer. A review of general progress, with an outline of the work of magnetic survey of the United States and contiguous territory. 7000 w. Tech Qr—June, 1907. No. 85718 E.

**Volumes.**

Determining Volumes of Coal in Bins and Piles. Charles Enzian. Gives methods and formulæ for finding the dimensions of masses of different forms either intact or partly tapped. 1700 w. Eng & Min Jour—July 27, 1907. No. 85955.

**Water Level.**

A Pictorial Appeal; — Water-Works Too. H. F. Dunham. Showing simple methods of making an accurate automatic record of the elevation of water, uninfluenced by wave action, for determining the changes in level of the Great Lakes. 3800 w. Pro Am Water-Wks Assn—1906. No. 85803 N.

**Water Meters.**

Simplex Water Meter. J. W. Ledoux. Describes the development of design and application of this meter to the flow of water through pipes. Ills. 1500 w. Pro Am Water-Wks Assn—1906. No. 85811 N.

## MUNICIPAL.

**Garbage Disposal.**

The Importance of Garbage Burning from an Electrical Point of View (Die Bedeutung der Müllverbrennung für die Elektrotechnik). G. Dettmar. A discussion of the possibility of developing electric power from the burning of city refuse, the first part discussing the average composition of garbage. 2500 w. Serial. 1st part. Elektrotech Zeitschr—June 27, 1907. No. 85688 D.

**Gary, Ind.**

The Municipal Works of Gary, Ind. Describes the extensive municipal improvements and public service system at this city which is being built in connection with the new plant of the United States Steel Corporation. Ills. 5700 w. Eng Rec—July 20, 1907. No. 85788.

**Kyoto, Japan.**

Municipal Engineering Works of Kyoto, Japan. S. Tanabe. Brief account of a new aqueduct and hydro-electric power plant; the Kyoto water supply; and city tramway. Ills. 500 w. Eng News—July 4, 1907. No. 85471.

**Pavements.**

Recent Progress in the Asphalt Paving Industry. Clifford Richardson. Read before the N. Y. Sec. of the Soc. of Chem. Ind. Briefly describes this industry in its early periods, and reviews the advances recently made. 3000 w. Engng-Con—June 26, 1907. Serial. 1st part. No. 85337.

**Road Hardening.**

The Soil of Our Roads and Streets (Le Sol de nos Routes et de nos Rues). G. Espitallier. An account of experiences in France in hardening and reducing dust on roads by surface applications, illustrating

*We supply copies of these articles. See page 1007.*

and describing methods and machines employed. 5500 w. Bull Soc d'Encour—May, 1907. No. 85609 G.

**Roads.**

See Civil Engineering, Construction.

**Sewage.**

The Determination of the Organic Nitrogen in Sewage by the Kjeldahl Process. Leyland Whipple. Presents results of experiments carried out on direct reading of Kjeldahl digestates, giving a procedure that has been found successful. 2200 w. Tech Qr—June, 1907. No. 85717 E.

**Sewage Disposal.**

Electricity in the Hanley Sewage Works. The method of driving the sewage distributors is illustrated and described, and the lighting of the works. 2200 w. Elec Engr, Lond—June 21, 1907. No. 85380 A.

Sewage Disposal by Dilution. George C. Whipple. Considers the subject from the viewpoint of the public health, and also from the viewpoint of nuisance. Discussion. 10000 w. No. 71. Pro Brooklyn Engrs' Club—1906. No. 85977 N.

**Sewer.**

Large Riveted Steel Sewers in Jersey City, N. J. Illustrates and describes an 8-ft. storm-water sewer under construction to serve the thickly settled Hudson City section. 1600 w. Eng Rec—July 13, 1907. No. 85544.

## WATER SUPPLY.

**Boston.**

Metropolitan Water Works. Dexter Brackett. An illustrated detailed description of these extensive works, which will supply nineteen municipalities within the present district. 10000 w. Pro Am Water Wks Assn—1906. No. 85817 N.

**Copper Sulphate.**

Copper Sulphate Results. James M. Caird. Presents results of treatment for algæ growths and bacteria by copper sulphate. 3300 w. Pro Am Water Wks Assn—1906. No. 85805 N.

**Dams.**

The Upper Grays Dam, Consolidated Water Co., Utica, N. Y. Illustrates and describes a dam built under unusual conditions as to foundations, and unusual requirements as to future extension. 600 w. Eng Rec—July 20, 1907. No. 85794.

Cheesman Dam. George T. Prince. Illustrates and describes the engineering features of this granite dam on the South Fork of the South Platte River. It has a height sufficient to store a depth of 212 feet of water and was constructed for the supply of the City of Denver. 3300 w. Pro Am Water Wks Assn—1906. No. 85816 N.

The Metropolitan Water Works System of Massachusetts. Caleb Mills Saville. Brief illustrated description of the construction of the Wachusett dam on the Nashua River, at Clinton. 1800 w. Munic Engng—July, 1907. No. 85715 C.

**Expansion.**

Expanding Water Supply Systems. J. T. Fanning. Discusses the losses due to undue expansion of the pipe lines, and the remedy. General discussion. 2500 w. Pro Am Water Wks Assn—1906. No. 85808 N.

**Filtration.**

Filtration of Water. F. A. W. Davis. Illustrated detailed description of the slow sand filtration plant of the Indianapolis Water Co., with tabulated summary of results. 2500 w. Pro Am Water Wks Assn—1906. No. 85797 N.

**Hackensack, N. J.**

Increasing the Capacity of the Hackensack Water Company's System by Introducing a Relay Pumping Station, as Compared with Cost of Building a New Force Main. D. W. French. An illustrated article, with map, explaining conditions and describing the plant at New Durham. Also gives the official test of the 12-million gallon Allis engine located at this station. 3000 w. Pro Am Water Wks Assn—1906. No. 85807 N.

**High Pressure.**

High Pressure Water Systems. F. L. Hand. An illustrated description of the Philadelphia high pressure fire service, giving estimates of first cost and cost of operation and maintenance. 10000 w. Pro Am Water Wks Assn—1906. No. 85815 N.

Proposed Auxiliary High Pressure Fire Protection Water Supply for Hartford, Conn. Particulars from an interesting report recently submitted to the Common Council. 800 w. Eng News—July 18, 1907. No. 85733.

**Irrigation.**

Proposed Irrigation System of the Wyoming Central Irrigation Co. for the Ceded Portion of the Shoshone or Wind River Indian Reservation. H. G. Raschbacher. An account of the surveys made and specifications agreed upon. Ills. 4500 w. Purdeu Engng Rev—1907. No. 85,930 N.

Irrigation in India. C. O. Burge. Deals particularly with the work in the Punjab and Scinde. 3000 w. Eng Rec—June 29, 1907. No. 85326.

**Mains.**

Extension and Improvements in the Supply Main, Yarmouth, N. S. George H. Robertson. An illustrated article giving a short description of the gate house, intake pipes and supply main, and methods used for extension and cleaning. 600 w. Pro Am Water Wks Assn—1906. No. 85801 N.

**Meters.**

Some New Facts Relating to the Effect

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of Meters on the Consumption of Water. William S. Johnson. Gives information on the use and waste of water, discussing why results expected from metering were not realized. General discussion. 17000 w. Jour N Eng Water Wks Assn—June, 1907. No. 85897 F.

See Civil Engineering, Measurement.

**Milwaukee, Wis.**

The Kinnickinnic River Flushing Tunnel and Pumping Station, Milwaukee, Wis. Illustrates and describes methods adopted to overcome troubles from river pollution. 2000 w. Eng Rec—July 27, 1907. No. 85944.

**Mödling, Austria.**

The Water Works System of Mödling (Das Wasserwerk der Stadt Mödling). Paul Frenz. Describes the hydro-electric power station, pumping plant, pipe lines and reservoir of the water system of this Austrian town. Ills 3000 w. Elektrotech u Maschinenbau—June 9, 1907. No. 85659 D.

**New York City.**

Inauguration of Work on the Catskill New York Water Supply. Map of the proposed system with brief account of inauguration of this gigantic enterprise. 1500 w. Sci Am—June 29, 1907. No. 85314.

**Pollution.**

River Pollution. Marshall O. Leighton. A discussion of its present status and suggestions concerning remedial policy. Discussion. 6500 w. Pro Am Water Wks Assn—1906. No. 85799 N.

A Judicial Review of American Stream Pollution Decisions. A review recently written by Judge Hainer of the Oklahoma Supreme Court. 4500 w. Eng Rec—June 29, 1907. No. 85323.

**Pumping Engines.**

See Mechanical Engineering, Steam Engineering.

**Pumping Stations.**

The Growth of the Pumping Station. Charles A. Hague. Reviews the development, especially during the last twenty years, the types, and the future outlook. Discussion. 9600 w. Pro Am Water Wks Assn—1906. No. 85809 N.

**Purification.**

Disinfection as a Means of Water Purification. George C. Whipple. Describes water-works at Ostende and Middelkerke, Belgium, where chlorine is used as a disinfecting adjunct to filtration. Gives list of articles on the manufacture and application of ozone. Discussion. 6800 w. Pro Am Water Wks Assn—1906. No. 85806 N.

Notes on Sewage Purification and Public Water Supplies. M. N. Baker. Outlines some of the available methods of sewage treatment, giving definitions of processes, and a bibliography. Discussion. 3500 w. Pro Am Water Wks Assn—1906. No. 85798 N.

Notes on Water Purification at St. Louis. W. F. Monfort. Abstract of a paper read before the Am. Water-Wks. Assn. A brief statement of chemical and bacterial results for the past year at one of the larger plants using lime and iron sulphate as coagulants, without the use of filters. 2500 w. Eng Rec—July 27, 1907. No. 85947.

**Reservoir.**

The Barren Jack Reservoir, New South Wales. Gives a general outline of the Barren Jack irrigation scheme, and describes the design of the dam and weir. 3000 w. Engng—July 5, 1907. No. 85589 A.

**Siphon.**

See Civil Engineering, Construction.

**Softening.**

Water Softening for Municipal Supplies. George W. Fuller. Considers some of the more important features upon which the treatment depends, and illustrates typical works. Discussion. 8500 w. Pro Am Water Wks Assn—1906. No. 85802 N.

**St. Catharines, Ont.**

St. Catharines' Waterworks. An illustrated historical account of this supply, stating the advantages secured through agreement with the Hamilton Cataract Power Company. 1500 w. Can Engr—July 5, 1907. No. 85407.

**St. Louis.**

The New Settling Basins and Other Improvements to the St. Louis, Mo., Water Supply System. Additions and extensions including two new settling basins, a 7-ft. steel pipe flow line, and a storage reservoir are illustrated and described. 5500 w. Eng Rec—July 6, 1907. No. 85458.

The Chicago Drainage Canal Case. William P. Mason. A brief historical sketch of the suit brought by the city of St. Louis to stop the diversion of Chicago sewage into the Mississippi valley. Introductory to abstracts of testimony by John W. Hill, Robert Spurr Weston, T. J. Burrill, Gardner S. Williams, Edwin O. Jordan, Leonard P. Kennicutt, Rudolph Herring, George W. Fuller, Allen Hazen, and others. 2500 w. Pro Am Water Wks Assn—1906. No. 85804 N.

**Typhoid.**

The Rôle of Public Water Supplies in the Spread of Typhoid Fever as Shown Chiefly by the Greatest Typhoid Epidemics. George A. Soper. Considers some of the ways in which water supplies become contaminated and how extensive the results may become. Discussion. 8500 w. Pro Am Water Wks Assn—1906. No. 85800 N.

Official Report on Typhoid Fever in Washington, D. C., in 1906. Information

from this comprehensive report, with editorial comment. 6500 w. Eng News—July 11, 1907. No. 85577.

**Valuation.**

A Retrospect of an Arbitration on the Value of a Water Works. Albert H. Wehr. Gives a statement of the method of value appraisal in the case with the City of Baltimore. Discussion. 8000 w. Pro Am Water Wks Assn—1906. No. 85813 N.

**Waste.**

The Photo-Pitometer and Water Works Losses. Edward S. Cole. Considers the waste of water and means for its control, and the use of the photo-pitometer for measuring the flow. Illustrates and describes the instrument. 4500 w. Tech Qr—June, 1907. No. 85716 E.

## WATERWAYS AND HARBORS.

**Bahia Blanca.**

The Port of Bahia Blanca (El Puerto de Bahia Blanca). Alejandro Foster. A description of this important harbor in the Argentine Republic. Ills. 5500 w. Ingenieria—May 15, 1907. No. 85620 D.

**Canals.**

The Harvey Canal and Lock. Gervais Lombard. Gives an interesting review of the history of this canal in Louisiana, with a report of recent work, the difficulties and methods of overcoming them. Ills. 4000 w. Jour Assn of Engng Soc's—June, 1907. No. 85895 C.

See also Civil Engineering, Bridges.

**Coal Tip.**

New Ferro-Concrete Jetty and Coal Tip at Port Talbot. An illustrated description of a new high-level coal tip, and the ferro-concrete jetty. 2000 w. Col Guard—July 19, 1907. No. 85990 A.

**Colorado River.**

Closing the Colorado River Crevasse. H. T. Cory. A brief review of this difficult and important engineering work. 4000 w. Purdue Engng Rev—1907. No. 85943 N.

The Diversion of the Colorado River into the Salton Sink and the Efforts Made to Restore it to Its Former Channel. J. A. Ockerson. An illustrated account of this disaster and the various attempts made to turn the river back to its channel, and the final success. 3500 w. Jour Assn of Engng Soc's—June, 1907. No. 85894 C.

**Concrete Structures.**

See Civil Engineering, Materials of Construction.

**Dam.**

Method of Constructing the Crockers Reef Dam, New York Barge Canal, Near Fort Edward, N. Y. Lindon Bates, Jr. Describes the first dam of the New York Barge Canal. It is mainly of second-class concrete, requiring about 3550 cu. yds. Ills. 1200 w. Engng-Con—July 10, 1907. No. 85563.

**Docks.**

Avonmouth Docks. Gives illustrations and information of progress in the construction of the Royal Edward Dock and entrance lock. 900 w. Engr, Lond—July 5, 1907. No. 85595 A.

The New Cardiff Dock. Gives the general plan of the Bute Docks, with remarks on their growth, and a detailed description of the new South Dock. Ills. 4800 w. Engr, Lond—July 12, 1907. No. 85875 A.

**Ferry Terminal.**

The Staten Island Ferry Terminal. Illustrated detailed description of the terminal facilities provided for the municipal ferry between Battery Park and St. George. 3000 w. Eng Rec—June 29, 1907. No. 85322.

**Galveston, Tex.**

See Civil Engineering, Construction.

**Mannheim, Germany.**

The Commercial Harbor at Mannheim (Der Industriehafen zu Mannheim). Herr Eisenlohr. Illustrated description of the harbor works at this important shipping point on the Rhine in Germany with details of the commerce handled. 3500 w. Serial. 2 parts. Deutsche Bau—June 8 and 15, 1907. No. 85639 each D.

**Panama Dams.**

The Isthmian Canal Dams in the Light of the Wachusetts Dam Landslip. Lindon W. Bates. Describes the slip occurring April 11, on the north dike of the Wachusett reservoir, and compares the design for the Gatun dam for the Panama Canal. Ills. 3500 w. Engng-Con—July 17, 1907. No. 85772.

**Water Level.**

See Civil Engineering, Measurement.

## MISCELLANY.

**Arches.**

Empirical Design of Reinforced Arches. Daniel B. Luten. Brief explanation of an empirical method based on the elastic theory devised by the writer. Ills. 1000 w. Purdue Engng Rev—1907. No. 85942 N.

The Symmetrical Masonry Arch; Analysis According to the Elastic Theory. Malverd A. Howe. An explanation of a method of determining the safety. 1200 w. R R Gaz—July 26, 1907. No. 85903.

**Beams.**

Diagrams for the Design of Reinforced Concrete Beams. Gives diagrams drawn by F. Teichman, with statement of their make-up and use. 2500 w. Eng News—July 11, 1907. No. 85571.

The Calculation of the Stresses in a Fixed Rod Subjected to both Compression and Bending (Der Eingespannte, auf

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Druck und Biegung beanspruchte Stab). Ivan Arnovlevic. Mathematical paper with diagrams and tables. 10000 w. Oesterr Wochenschr f d Oeffent Bau—June 1, 1907. No. 85673 D.

**Lettering.**

An Improved System of Lettering Maps and Drawings. Henri V. Lemenager. A brief description of a system of type-printed lettering, which has been in successful use in the drafting section of the Reclamation Service. 900 w. Eng News—July 18, 1907. No. 85737.

**Reclamation.**

Work of the United States Reclamation Service. F. H. Newell. Explains the provisions of the Reclamation Act and gives an illustrated account of the work in progress. 3500 w. Jour Fr Inst—July, 1907. No. 85702 D.

**Rib Beams.**

Calculation of Reinforced-Concrete Rib Beams of the Lowest and Most Favorable Height (Berechnung der Rippenbalken aus Eisenbeton von Niedrigster und Vorteilhaftester Höhe). Prof. Ramisch. Mathematical paper. 2000 w. Serial. 1st part. Elektrotech u Polytech Rundschau —June 26, 1907. No. 85647 D.

**Wind Stresses.**

Wind Reactions in Mill-Building Frames. C. H. Wood. Aims to put the formulæ of Prof. Sondericker in such simple shape that they can be more easily applied in practical design. 900 w. Eng News—July 18, 1907. No. 85735.

# ELECTRICAL ENGINEERING

## COMMUNICATION.

**Radiotelegraphy.**

Wireless Telegraphy—Some of Its Practical and Commercial Aspects. William Maver, Jr. Read at the convention of the Assn. of Ry. Tel. Supts. The present service of wireless telegraphy, recent improvements, and the limitations of the system are discussed. 3000 w. Elec Rev, N Y—July 13, 1907. No. 85534.

Wireless Telegraphy: A Solution of the Problem of Selectivity. I. Hettinger. Abstract of a specification of a British patent recently granted the writer for a method of selective wireless telegraphy wherein the selectivity is secured independently of the magnitude of the power and distance of transmission of the interfering station. 2000 w. Elec Engr, Lond—June 21, 1907. No. 85381 A.

Spark Telegraphy (Die Funkentelegraphie). A. Linker. A review of the theory and development of radiotelegraphy, discussing the work of the leading investigators. Ills. 3000 w. Serial. 2 parts. Eisenbahntech Zeitschr—June 12 and 26, 1907. No. 85665 each D.

**Telegraph Poles.**

Experiments with Concrete Telegraph Poles. G. A. Cellar. Gives results of tests made by the Pennsylvania Lines west of Pittsburg. Ills. 700 w. Elec Wld—June 29, 1907. No. 85350.

**Telegraphy.**

Central-Battery Telegraphs. A brief illustrated description of the British post-office arrangements as applied to duplex and omnibus circuits. 1200 w. Elec Rev, Lond—June 28, 1907. No. 85496 A.

Examination of Telegraphers for Railroad Work. H. C. Hope. Read before the Rv. Tel. Supts.' Assn. An account of the required examination. 1500 w. R R Gaz—July 5, 1907. No. 85466.

Inductive Disturbances to Telegraph Lines. John B. Taylor. Read before the Assn. of Ry. Tel. Supts. Discusses factors affecting induction in telegraph lines and the elimination of disturbance. 3000 w. Ry Age—July 12, 1907. No. 85556.

**Telemechanic.**

The Branly "Telemechanic" System. C. L. Durand. Prof. Branly's system, of operating mechanical devices from a distant point, is illustrated and described. 2500 w. Elec Rev, N Y—July 27, 1907. No. 85950.

**Telephone Cables.**

Aerial Cable Construction for Telephone Exchanges. C. W. Burkett. An illustrated article discussing the practical and technical details. 3500 w. Cassier's Mag—July, 1907. No. 85711 B.

**Telephony.**

Magneto Generators. L. J. Flint. Considers the magneto generator used in local battery telephones, explaining a few of the reactions and favoring the rigid field end shaft construction. 2000 w. Purdue Engng Rev—1907. No. 85931 N.

**Wireless Telephone.**

How to Construct a Simple Wireless Telephone. A. Frederick Collins. Illustrates and describes a construction that will give results up to 30 or 40 feet and operate through ordinary walls. An application of electro-magnetic induction. 2000 w. Sci Am Sup—July 20, 1907. No. 85742.

## DISTRIBUTION.

**Conductors.**

The Heating of Copper Wires by Electric Currents. A. E. Kennelly and E. R.

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Shepard. A report of research work in the measurement of temperature elevation of electric cables so far as relates to wires in water, soil, or wooden moulding. 5000 w. Pro Am Inst of Elec Engrs—June, 1907. No. 85752 D.

Power Factor, Alternating-Current Inductive Capacity, Chemical and Other Tests of Rubber-Covered Wires of Different Manufacturers. Henry W. Fisher. Gives results of tests made, one of the objects being to see if power-factor tests would not give an insight into the qualities of different makes of rubber-insulated wires. 3000 w. Pro Am Inst of Elec Engrs—June, 1907. No. 85754 D.

**Rectifiers.**

Tests of a Mercury Current Rectifier (Untersuchung eines Quecksilbergleichrichters). Dr. Josef Polak. Describes the apparatus, which was of the ordinary type produced by the General Electric Company, and gives the results of tests with curves and tables. Ills. 2000 w. Elektrotech u Maschinenbau—June 2, 1907. No. 85658 D.

Tests on a Mercury-Vapor Rectifier. Brief account of tests carried out by J. Polak, as described in a recent number of *Elektrotechnik und Maschinenbau*. Diagrams. 700 w. Elec Engr, Lond—July 12, 1907. No. 85861 A.

**Rotary Converters.**

Heating Effect of Quadrature Currents in Rotary Converters. J. H. Hunt. Gives a mathematical comparison of the heating effect in rotary converters and in synchronous motors or alternating-current generators. 800 w. Elec Wld—July 27, 1907. No. 85958.

**Sub-Stations.**

Sub-Station Equipment and Operation, Chicago Edison Company and Commonwealth Electric Company. R. G. Grant. Describes the equipment of a standard sub-station, tracing the current from the transmission line to the center of distribution. 3000 w. Elec Wld—July 27, 1907. No. 85959.

The Rotary Converter Sub-Station. R. F. Schuchardt. Describes the essential constructional details of these stations and the manner of operating them in Chicago. General discussion. Ills. 7800 w. Jour W Soc of Engrs—June 1, 1907. No. 85725 D.

**Wiring.**

Wiring Plans for Heating Appliances. F. M. Feiker. Gives suggestions for wiring houses costing $5000 to $7000. Ills. 1000 w. Elec Rev, N Y—July 13, 1907. No. 85533.

## DYNAMOS AND MOTORS.

**Insulation.**

The Selection of Machine Insulation Material. William S. Conant. Discusses materials intended for the insulation of electric machinery, methods of testing them, and the effects of certain ingredients. 3000 w. Elec Wld—July 20, 1907. No. 85847.

**Single-Phase.**

The New Double-Circuit Single-Phase Motor of the Felten & Guilleaume-Lahmeyer Works. M. Osnos. Abstract from the *Elektrotechnische Zeitschrift*. In the present article this motor is considered as a lift motor, showing how it fulfils the requirements. 1500 w. Elect'n, Lond—July 12, 1907. No. 85865 A.

**Synchronous.**

Interaction of Synchronous Machines. Morgan Brooks. Presents a new circle diagram showing the physical relation of the quantities and conditions involved, deriving fundamental equations, and developing simple loci for solving the problems of synchronous operation. 5000 w. Pro Am Inst of Elec Engrs—June, 1907. No. 85753 D.

**Three-Wire.**

Three-Wire Dynamos. Illustrates and describes various types of three-wire dynamos. 1800 w. Elec Wld—July 20, 1907. No. 85850.

**Variable Speed.**

A New Variable Speed Electric Motor or Variable Voltage Dynamo. Dr. L. Torda. An illustrated description of a variable speed motor or a variable voltage generator with reluctance control which has been devised by the author. 2500 w. Elect'n, Lond—July 5, 1907. No. 85583 A.

## ELECTRO-CHEMISTRY.

**Calcium Cyanamide.**

The Calcium Cyanamide Industry (Sull Industria della Calciocianamide). A review of the history of this industry, outlining the process of manufacture and giving costs. 2200 w. Industria—June 2, 1907. No. 85623 D.

**Carbon Tetrachloride.**

Manufacture and Uses of Carbon Tetrachloride. J. R. Crocker. Gives information in regard to carbon tetrachloride and illustrates and describes apparatus for its production. 3300 w. Elec-Chem & Met Ind—July, 1907. No. 85487 C.

**Corrosion.**

The Effect of Stress Upon Corrosion of Iron. Prof. William H. Walker and Mr. Colby Dill. Abstract of a paper describing investigations and results. Also abstract of paper by Dr. A. S. Cushman offering a new electrolytic theory of the corrosion of iron, and editorial. 4500 w. Elec-Chem & Met Ind—July, 1907. No. 85488 C.

**Detinning.**

Electric Detinning of Tinplate Scrap.

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G. Crudo. Compiled from *Rassegna Mineraria.* Information concerning the author's work in this field, describing processes and examining the economic conditions. 1500 w. Min Jour—July 13, 1907. No. 85868 A.

**Electrometallurgy.**

The Electric Furnace in Steel Making and Copper Smelting. T. Scott Anderson. Considers the application of the electric furnace to ore reduction, describing the author's patents. 1500 w. Eng & Min Jour—June 29, 1907. No. 85331.

**Electroplating.**

Sheffield Plate and Electro-Plate. Sherard Cowper-Coles. Gives historical sketches of Sheffield plate and electro-plate, describing methods, testing, etc. Ills. 6000 w. Jour Soc of Arts—July 12, 1907. Serial. 1st part. No. 85851 A.

Electro-Deposition of Brass. Charles H. Proctor. Read before the Am. Found. Assn. Suggestions on the electro-deposition of brass upon baser metals. 1000 w. Foundry—July, 1907. No. 85750.

**Nitrogen.**

The Electro-Thermic Combustion of Atmospheric Nitrogen. F. Howles. Read before the Soc. of Chem. Ind. Discusses the factors involved and gives a general summary of what has been accomplished. 4800 w. Elect'n, Lond—July 19. 1907. No. 85985 A.

## ELECTRO-PHYSICS.

**Dielectrics.**

Physical Characteristics of Dielectrics. A. P. M. Fleming. A study of the effects produced by electrostatic stresses in gases, liquids, and solids. 2500 w. Elec Jour—July, 1907. No. 85706.

**Insulation.**

Face of Insulating Materials Under Oil. J. W. Esterline, J. R. Clark, J. E. Breese. Illustrated report of a series of investigations. 1000 w. Purdue Engng Rev—1907. No. 85941 N.

**Oscillatory Discharge.**

The Oscillatory Discharge in Iron Wires. A. Battelli and L. Magri. Translated from *Physikalische Zeit.* Gives results of investigations. 2200 w. Elect'n, Lond—July 12, 1907. No. 85866 A.

**Vibrations.**

The Superposition of Mechanical Vibrations (Electric Oscillations) upon Magnetization, and Conversely, in Iron, Steel and Nickel. James Russell. An account of investigations on the subject. 3300 w. Elect'n, Lond—July 5, 1907. No. 85585 A.

## GENERATING STATIONS.

**Alternators.**

Compounded Alternators with Commutators. A. Heyland. Describes practical experiences with some large compounded alternators which have been running several years. Ills. 1500 w. Elect'n, Lond—July 19, 1907. No. 85987 A.

**Balancers.**

Balancers versus Three-Wire Dynamos. Budd Frankenfield. Read before the Nat. Elec. Lgt. Assn. An interesting discussion of the advantages of the balancer for three-wire lighting sets. 4500 w. Elec Rev, N Y—July 13, 1907. No. 85536.

**Costs.**

The Costs of Electricity Supply and Their Relation to Scales of Charges. H. R. Burnett. Read before the Incor. Munic. Elec. Assn. Describes the method adopted by the writer for ascertaining the costs of supply and the manner of applying the information in fixing the scale of charges. 3500 w. Elec Engr, Lond—July 5, 1907. No. 85580 A.

Cheap Power Supply by Municipalities. C. E. S. Shawfield. Discusses some of the general principles involved in the problem of cheap power supply. 3000 w. Elec Engr, Lond—June 28, 1907. No. 85495 A.

**Depreciation.**

See Industrial Economy.

**Generating Sets.**

Upkeep Charges on Large Electric Generating Sets. Henry Robert John Burstall and John Somerville Highfield. Read at Engng. Con. of the Inst. of Civ. Engrs. Aims to draw out information as to the differences which may exist in the charges necessary to cover repairs and maintenance. Discussion. 1800 w. Elec Engr, Lond—June 21, 1907. No. 85384 A.

**Hydro-Electric.**

Hydraulic Development at West Buxton, Me. Illustrated description of a hydraulic plant on the Saco River involving the construction of a dam, a power house, a dynamo house, a boom, a log-chute, and a tail race. Current to be transmitted to Portland. 2200 w. Eng Rec—July 27, 1907. No. 85948.

Method of Construction of the Water Power Plant on the Chicago Drainage Canal. LeRoy K. Sherman. Illustrated description of this hydro-electric development of 36000 h.p. now nearing completion. 1500 w. Engng-Con—July 3, 1907. No. 85438.

Novel Features of the Huronian Company's Water Power Development. High Falls, Ontario. Brief illustrated description of the dams and constructional features. 1500 w. Eng News—July 18, 1907. No. 85731.

The Hydro-Electric Plant of the Vancouver Power Co. Detailed description of a plant supplying power for electric lighting, street railways, and commercial purposes in Vancouver, B. C., and sur-

rounding towns. 2500 w. Eng Rec—July 13, 1907. No. 85542.

The Hydro-Electric Power Development of the M'Call Ferry Power Co. H. T. Herrick. Brief illustrated account of the construction of this dam on the Susquehanna River, and the power plant. 1000 w. Purdue Engng Rev—1907. No. 85936 N.

The Nine-Mile Power Station of the Spokane & Inland Empire Railway. H. Cole Estep. Illustrations, with description of the method of construction, and the design. 1200 w. Eng Rec—July 20, 1907. No. 85792.

The Taylor's Falls, Minn., Water-Power Development. An illustrated detailed description of an important water power development on the St. Croix River, which supplies current for lighting and power to Minneapolis and surrounding districts. 2500 w. Eng Rec—June 29, 1907. Serial. 1st part. No. 85319.

The Power Plant on the Sill at Innsbruck (Die Sillwerke bei Innsbruck). An illustrated description of this important hydro-electric power plant in the Tyrol which supplies electrical energy for lighting and power purposes in Innsbruck and also for the operation of the Stubai Valley Railway. 2000 w. Serial. 1st part. Der Elektrotechniker—June 10, 1907. No. 85649 D.

The Electrical Plants on the Traun and in St. Wolfgang (Das Traunfallwerk und die Elektrizitätswerke in St. Wolfgang). Illustrated detailed description of these power stations and transmission systems in Austria. 2500 w. Elektrotech u Maschinenbau—June 30, 1907. No. 85663 D.

**Municipal.**

The Municipal Electric Plant at The Hague (De Gemeentelijke Electriciteitsfabriek te 's-Gravenhage). N. J. Singels. An illustrated description of the design and equipment of this large municipal generating station with details of operation and costs. 4500 w. De Ingenieur—June 1, 1907. No. 85689 D.

**New Machinery.**

New Electric Machines and Appliances (Neuere Elektrische Maschinen und Geräte). K. Meyer. Illustrates and describes recent types of machinery developed by the Siemens-Schuckert Company, including armatures, turbo-dynamos, transformers, switches, etc. 6000 w. Zeitschr d Ver Deutscher Ing—June 1, 1907. No. 85676 D.

**Oiling System.**

An Oiling System in a Large Power Plant. Plan and description of the lubricating-oil circulating system in the Long Island City power station of the Pennsylvania R. R. 700 w. Elec Age—July, 1907. No. 85837.

**Parallel Operation.**

Reactions Between Compound-Wound Generators Operating in Parallel. Clarence A. Boddie. An explanation of how and why the machines are mutually adjusting. 2400 w. Power—July, 1907. No. 85344 C.

**Plant Equipment.**

Effect of Power Factor on Plant Equipment. Prof. J. H. Dobson. Shows that by proper plant equipment the efficiency of running can be increased; and the transformer, distributing and generator losses considerably reduced and capital expenditure saved—May, 1907. No. 85377 F.

**Power Plants.**

Cleveland Arcade Electrical Plant. A recently completed plant for office building purposes, containing unusual features, is illustrated and described. 3000 w. Elec Wld—July 20, 1907. No. 85846.

Equipment for the Pacific Light & Power Co.'s Plant. Illustrates and describes horizontal vertical-compound engines with surface condensers, driving alternating-current generators. 2500 w. Engr, U S A—July 1, 1907. No. 85371 C.

Electrical Equipment of the Hall of Records in Manhattan Borough, New York City. Illustrated detailed description of the power plant, distribution of circuits, and features of illumination. 3000 w. Elec Wld—July 27, 1907. No. 85957.

The Stratford Power Station of the Great Eastern Railway. Illustrated description of this modern turbo-generating plant. 2500 w. Elec Rev, Lond—July 12, 1907. No. 85863 A.

**Switchboards.**

Switchboard Practice for Voltages of 60000 and Upwards. Stephen Q. Hayes. Discusses the chief points of interest in connection with high-voltage switchboard practice. Ills. 5500 w. Pro Am Inst of Elec Engrs—June, 1907. No. 85761 D.

**Switchgear.**

Central Station Switchgear, Etc. Arthur Imbery. Considers direct-current switchgear, etc., as used in central stations, supplying electrical energy for lighting, power and tramway purposes. Ills. 1200 w. Elec Engr, Lond—July 12, 1907. No. 85860 A.

**Tasmania.**

Launceston, Tasmania. An illustrated report on the electricity works by William Corin, giving a résumé of progress, and an idea of the probable extensions. 4500 w. Elec Engr, Lond—July 5, 1907. No. 85581 A.

**Turbo-Generator.**

Tests and Operating Results on the 5500-KW Turbo-Generator of the Interborough Rapid Transit Company. Gives

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tables and diagram showing the results of tests. 800 w. Elec Jour—July, 1907. No. 85708.

## LIGHTING.

**Arc Lamps.**

Arc Lamps for Railway Car Illumination; Their Distribution and Characteristics. Alfred L. Eustace. A system recently installed in a car on the Chicago & Northwestern Railway is illustrated and described. It is on trial service between Chicago and Waukegan. 2200 w. Elec Wld—July 13, 1907. No. 85564.

Enclosed Arc Lamps. W. Wedding. Abstract translation from *Elektrische Kraftbetriebe u. Bahnen.* Describes tests and gives results. 1800 w. Elect'n, Lond—June 21, 1907. No. 85389 A.

**Illumination.**

Illumination and Some Illuminants. J. D. Mackenzie. Abstract of paper read before the Glasgow Sec. of the Inst. of Elec. Engrs. Discusses necessary qualifications for successful illumination and how they may be attained in practice. 2000 w. Elect'n, Lond—June 21, 1907. No. 85390 A.

Recent Advances in Artificial Lighting. Information of new incandescent lamps recently put on the market, with illustrations. Also recent advances in gas lighting. 7500 w. Eng News—July 25, 1907. No. 85890.

The Fundamental Principle of Artificial Illumination. Editorial on the principles governing safe and useful applications of light. 3500 w. Eng News—July 25, 1907. No. 85891.

**Incandescent Lamps.**

The Improvement of the Incandescent Lamp. R. Milward Ellis. Considers the improvement of the carbon filament, and other filaments for incandescent lamps. 2500 w. Elec Engr, Lond—July 19, 1907. Serial. 1st part. No. 85984 A.

Modern Incandescent Lamps (Modernas Lámparas Eléctricas de Incandescencia). Sancho López López. The first part of the serial deals with the osminum lamp. Ills. Serial. 1st part. 4000 w. Energia Elec—June 10, 1907. No. 85619 D.

**Mercury Arcs.**

Tests of a Mercury Arc Lamp. A. N. Topping. Brief description of the main points in these lamps, with account of tests. Ills. 3000 w. Purdue Engng Rev —1907. No. 85940 N.

The Mercury Arc and Its Technical Applications (Der Quecksilber-Lichtbogen und seine Technische Verwendung). Josef Polak. The first part of the serial discusses the physical principles on which the mercury vapor lamp is constructed. Ills. 4500 w. Serial. 1st part. Elektrotech Zeitschr—June 13, 1907. No. 85686 D.

**Photometry.**

See Electrical Engineering, Measurement.

**Street Lighting.**

Suggested Specifications for Street Lighting. Report to the National Electric Light Association by a committee, with editorial comment unfavorable to the adoption of the specifications. 3200 w. Eng Rec—July 20, 1907. No. 85791.

## MEASUREMENT.

**Cymometer.**

The Fleming Direct-Reading Cymometer. A Frederick Collins. Illustrated description of an instrument for measuring wireless telegraph waves. 1500 w. Sci Am Sup—July 27, 1907. No. 85893.

**Dielectrics.**

On the Loss of Energy in the Dielectric of Condensers and Cables. Dr. Bruno Monasch. Gives a method of measuring dielectric losses and discusses the sources of error to be avoided. 3000 w. Elect'n, Lond—June 28, 1907. Serial. 1st part. No. 85497 A.

**Hysteresis.**

On a Method of Plotting the Hysteresis Loop for Iron with an Application to a Transformer. Dr. Gisbert Kapp. Describes test. 700 w. Elect'n, Lond—July 12, 1907. No. 85867 A.

**Iron Losses.**

The Separation of the Iron Losses in Asynchronous Machines. Thomas F. Wall. Shows how these losses may be separated without the use of retardation curves, and the results of experiments on a 5 h.p. motor. 2500 w. Elect'n, Lond—June 21, 1907. No. 85388 A.

**Light Units.**

A Comparison of the Unit of Luminous Intensity of the United States with Those of Germany, England, and France. Edward P. Hyde. Abstracted from the *Bulletin* of the Bureau of Standards. 2500 w. Elect'n, Lond—July 19, 1907. No. 85988 A.

**Meters.**

Elements Affecting the Accuracy of Induction Type Watt-Hour Meters. H. W. Young. Illustrates and describes an improved bearing of the "rolling" type, explaining its advantages, and an improved method of light load adjustment. 3500 w. Elec Wld—June 29, 1907. No. 85351.

**Photometry.**

The Value of Photometry in Central-Station Practice. Robert McCourt. Shows what can be done with a few simple instruments with a fair degree of accuracy. 3500 w. Elec Engr, Lond—July 12, 1907. No. 85862 A.

**Power Factor.**

Graphical Method of Determining Power Factor from Wattmeter Readings. A. A. Radtke. Brief explanation of meth-

od. 400 w. Elec Wld—July 20, 1907. No. 85848.

**Switchboards.**

Switchboards for Testing Work. Leonard Solomon. Considers the design of switchboards used for testing purposes, and describes the switchboard at present in use at the Central Technical College. Ills. 2800 w. Elect'n, Lond—July 12, 1907. No. 85864 A.

**Testing Plant.**

A Brief Description of the Testing Department of the General Electric Company; (Schenectady Works). E. L. Simpson. Descriptive of the training given students in this department. Ills. 6000 w. Purdue Engng Rev—1907. No. 85939 N.

**Transformer Testing.**

A New Method of Artificially Loading Transformers (Eine Neue Methode zur Künstlichen Belastung von Transformatoren). Axel F. Gustrin. Gives diagrams illustrating the wiring arrangements for this method of testing transformers, in which the transformer under test is self-loading. 1600 w. Elektrotech Zeitschr—June 6, 1907. No. 85684 D.

Notes on Transformer Testing. H. W. Tobey. Describes methods adopted in commercial transformer testing which have proved satisfactory, explaining their advantages and shortcomings. 3500 w. Pro Am Inst of Elec Engrs—June, 1907. No. 85758 D.

## TRANSMISSION.

**Cables.**

An Investigation of the Loss of Voltage in Cables (Untersuchung über den Spannungsverlust in Kabeln). E. Stirnimann. A theoretical discussion of the losses of voltage in cables of large section, illustrated by curves, tables and diagrams. 7000 w. Serial, 2 parts. Elektrotech Zeitschr—June 6 and 13, 1907. No. 85685 each D.

**Direct Current.**

Critical Remarks on Electric Power Transmission by High-Pressure Direct Current (Kritische Betrachtungen über das System der Elektrischen Kraftübertragung mit Hochgespanntem Gleichstrom). A criticism of the paper on the series system of high-tension, direct-current transmission read by J. S. Highfield before the Institution of Electrical Engineers, March 7, 1907. Ills. 3000 w. Elektrotech u Maschinenbau—June 23, 1907. No. 85662 D.

**High Tension.**

Some New Methods in High-Tension Line Construction. H. W. Buck. Describes a method of line construction believed to offer a means of operating a line safely at higher potentials than is practicable with insulators of the pin and petticoat type. 1000 w. Pro Am Inst of Elec Engrs—June, 1907. No. 85760 D.

**Insulators.**

A New Type of Insulator for High-Tension Transmission Lines. E. M. Hewlett. Illustrated description of "link insulators" of the suspension and strain type. 500 w. Pro Am Inst of Elec Engrs—June, 1907. No. 85759 D.

**Large Systems.**

The Development and Operation of a Large Electric Transmission and Conversion System. Ernest F. Smith. Refers particularly to the systems of the Chicago Edison and Commonwealth Electric companies as representing the best American practice. Discussion. Ills. 12900 w. Jour W Soc of Engrs—June, 1907. No. 85726 D.

**Lightning Arresters.**

A Proposed Lightning-Arrester Test. N. J. Neall. Describes the proposed test, illustrating it by wiring diagrams, and explaining its advantages. 800 w. Pro Am Inst of Elec Engrs—June, 1907. No. 85757 D.

Practical Testing of Commercial Lightning-Arresters. Percy H. Thomas. Discusses what tests should be incorporated in the standardization rules of the Am. Inst. of Elec. Engrs. 13000 w. Pro Am Inst of Elec Engrs—June, 1907. No. 85756 D.

**Lightning Protection.**

Ground Wires and Choke-Coils for Lightning Protection. D. S. Carpenter. Considers that the overhead ground wire with lightning arresters at intervals along the line affords the best possible protection. 1200 w. Elec Wld—July 20, 1907. No. 85849.

Protective Apparatus Engineering. E. E. F. Creighton. Describes methods which have been in use in the development of lightning apparatus. 15600 w. Pro Am Inst of Elec Engrs—June, 1907. No. 85755 D.

**Line Extensions.**

Extension of Electricity Supply to Outlying Districts. R. L. Acland. Abstract of a paper read before the Incorporated Municipal Electric Association. Describes the scheme adopted for supplying a district, 2½ miles from the power house, with power for electric lighting. 1500 w. Mech Engr—July 13, 1907. No. 85858 A.

**Niagara.**

Canadian Niagara Power Company's Transmission to Buffalo. Illustrated description of novel features in the long crossing of the transmission lines, and of terminal station "B" of the Cataract Power & Conduit Co. 2500 w. Elec Wld—June 29, 1907. No. 85349.

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**Poles.**

See Electrical Engineering, Communication.

**Three-Phase.**

Neutral Currents of a Three-Phase Grounded System. George I. Rhodes. Considers causes producing phase displacement and variation in magnitude of the generated e. m. f. waves. 1200 w. Elec Jour—July, 1907. No. 85707.

### MISCELLANY.

**Lightning Protection.**

Standard Lightning Protection for the Consolidated Power Plant Chimneys at United States Navy Yards. N. Monroe Hopkins. Describes the design of lightning protection for chimneys, giving illustrations of experiments which show reasons for the general features, and the approved specifications. 3500 w. Jour Am Soc of Nav Engrs—May, 1907. No. 85764 H.

**Waves.**

Applications of Hertzian Waves (Aplicaciones de las Ondas Hertzianas). G. J. de G. Garcia. The first instalment deals principally with the methods of producing electric waves and their naval applications. Ills. 8000 w. Revista Tech Ind—June, 1907. No. 85695 D.

## INDUSTRIAL ECONOMY

**America.**

Industrial America. J. E. Livermore. Comments by a British workman on American machine-shop conditions. Ills. 2500 w. Cassier's Mag—July, 1907. Serial. 1st part. No. 85713 B.

**American Railways.**

The Crisis in the Railway Affairs of the United States (La Crise des Chemins de Fer aux Etats-Unis). G. M. Boissevain. A discussion of the financial condition of the railways of the United States, outlining the causes of the recent drop in the value of securities and the prospects of the future. Tables. 6000 w. Rev Inter Econ—June, 1907. No. 85606 H.

**Apprenticeship.**

A Rational Apprentice System. Gives extract from Mr. Deems' address before the Master Mechanics' Assn., and the paper of C. W. Cross and W. B. Russell. Also discussion. 12500 w. Am Engr & R R Jour—July, 1907. No. 85408 C.

The Improvement of Opportunity for the Young Workman. George Frederick Stratton. Outlines the apprenticeship system devised by the General Electric Company, and shows the advantages of study with correspondence schools. 2000 w. Engineering Magazine—Aug., 1907. No. 85920 B.

**Argentine Republic.**

The Argentine Republic and Its Economic Development (La République Argentine et son Développement Economique). Maurice Lewandowski. Describes the great commercial importance of Argentina, its resources, railways, rivers, etc., outlining the enormous progress made in recent years. 16000 w. Rev Inter Econ—June, 1907. No. 85607 H.

**Bills of Lading.**

The Uniform Bill of Lading. Discusses the bill proposed by the Interstate Commerce Commission. 2000 w. Ir Age—July 18, 1907. No. 85730.

**Brazil.**

The Brazil of the Present (Le Brésil Contemporain). E. Levasseur. A review of the economical progress of Brazil during the last fifteen years, describing its resources, mineral wealth, commerce, railways, etc. Tables. 10500 w. Rev Inter Econ—June, 1907. No. 85605 H.

**British Industry.**

The Trust Movement in British Industry. Reviews a recent book on this subject by Henry W. Macrosty, discussing the reasons why trusts are formed and related matters. 4000 w. Ir Age—July 4, 1907. No. 85442.

**Cost Keeping.**

Cost Keeping as an Aid in Managing Men. Halbert P. Gillette. Outlines the old method of management, and discusses cost keeping as a means of determining the efficiency of labor. 4000 w. Engng-Con—July 17, 1907. No. 85771.

Cost Keeping in Large Plants (Aus der Praxis des Rechnungswesens in Grossbetrieben). C. Redtmann. Discusses the theory of cost keeping in machine shops. Ills. 1800 w. Serial. 1st part. Zeitschr f Werkzeugmaschinen u Werkzeuge—June 25, 1907. No. 85655 D.

**Depreciation.**

Depreciation and Reserves for Antiquation and Obsolescence from an Engineering Standpoint. C. H. Yeaman. Abstract of a paper before the Incor. Munic. Elec. Assn. Also discussion. 4500 w. Elect'n, Lond—July 5, 1907. No. 85584 A.

Adequate Depreciation of Capital Expenditure by Municipal Electricity Undertakings. J. Horace Bowden and Fred Tait. A discussion of this subject, with suggestions. 3000 w. Elec Rev, Lond—June 21, 1907. Serial. 1st part. No. 85387 A.

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**Education.**

The Relation of Engineering Schools to Polytechnic Education. Dugald C. Jackson. Presidential address delivered at the Cleveland meeting of the Society for the Promotion of Engineering Education. 4000 w. Ir Trds Rev—July 11, 1907. No. 85529.

The Engineering Side at Bedford Grammar School. Editorial on the work being done at this school, which aims to give instruction that will really assist in the boy's progress. Ills. 2000 w. Engng—July 12, 1907. No. 85872 A.

**Employers' Liability.**

Workmen's Compensation and Insurance. Jos. J. H. Stansfield. Deals with the effect of the new Employers' Liability Act upon the position of the manufacturer, and shows that, in some ways, the act is obscure. 2800 w. Elect'n, Lond—June 28, 1907. No. 85498 A.

**Government Control.**

The Canadian Railway Commission. J. G. G. Kerry. An account of the work intrusted to this commission in the regulation of railways. 5000 w. Engineering Magazine—Aug., 1907. No. 85912 B.

**Indexing.**

An Inexpensive Indexing System. William E. Reed. Describes a system used by the writer. 1500 w. Am Mach—Vol. 30, No. 29. No. 85774.

**Industrial Betterment.**

How One Corporation Helped Its Employees. Lawrence Lewis. An illustrated account of social betterment work of the Colorado Fuel and Iron Company. 4000 w. Eng & Min Jour—June 29, 1907. No. 85332.

**Industrial Legislation.**

Industrial Legislation and Its Cost. T. Good. Discusses the effect in Great Britain of the application of legislation to industrial ills. Argues that the benefits cost far more than they would if other means were taken. 3500 w. Cassier's Mag—July, 1907. No. 85710 B.

**Industrial Museums.**

A Visit to the German Museum at Munich (Ein Besuch im Deutschen Museum in München). Conrad Matschosz. A description of the exhibits at this large and important technical museum. Ills. 3000 w. Zeitschr d Ver Deutscher Ing—June 22, 1907. No. 85679 D.

A Museum of Traffic and Engineering. Dr. Alfred Gradenwitz. An illustrated description of an industrial museum in Germany, the exhibits principally devoted to railroad engineering. 2000 w. Engineering Magazine—Aug., 1907. No. 85913 B.

**Iron Industry.**

First Quinquennial Census of the Iron and Steel Industry. Reviews the report compiled by Story B. Ladd. 6500 w. Ir Age—July 4, 1907. No. 85441.

**Management.**

Profit Making in Shop and Factory Management. C. U. Carpenter. This seventh of a series of articles gives a study of the proper time of assembling work. 2200 w. Engineering Magazine—Aug., 1907. No. 85916 B.

Notes on Works Management. R. A. Smart. Outlines the requisites of an industrial organization, discussing some of the more important functions and the methods in common use for controlling them. 3500 w. Purdue Engng Rev—1907. No. 85932 N.

The Proper Management of Labor, a Weighty Factor in Commercial Success (Richtige Arbeitsdisposition, ein wichtiger Faktor des Finanziellen Erfolges). Max Arbeiter. Discusses cost keeping, works organization, etc., with examples of methods from actual plants. Ills. 2500 w. Elektrotech u Maschinenbau—June 9, 1907. No. 85660 D.

**Municipal Ownership.**

Expert Investigations in Municipal Ownership. Information from a general review of the examinations made in the United States of municipal and private plants by the Municipal Ownership Committee of the National Civic Federation. 2500 w. Elec Wld—July 20, 1907. Serial. 1st part. No. 85845.

**Railway Construction.**

The Engineering Organization of the Western Pacific Railway Company. George P. Low. Describes the engineering organization for one of the heaviest pieces of railway building ever undertaken, covering 76 miles between Oroville and Spanish Creek Crossing, Cal. 5000 w. Eng Rec—Aug. 3, 1907. No. 86086.

**Shop Routine.**

The Passage of an Order Through Office and Shop. W. R. Koller. Follows the more important steps of the order and that part of the routine in office and shop which bears directly on its passage Explains the card-filing system. Ills. Discussion. 10700 w. No. 67. Pro Brooklyn Engrs' Club—1906. No. 85973 N.

**Tariff.**

French Tariff Negotiations. A statement of the attitude of the French Government toward the reciprocity treaty, calling attention to a forgotten law, and outlining the satisfactory negotiations now being conducted. 1100 w. Ir Age—July 18, 1907. No. 85729.

**Tin Plate.**

Quinquennial Census of the Tin and Terne Plate Industry. A review of the report for the quinquennial census of 1905, prepared by Story B. Ladd. 2000 w. Ir Age—July 11, 1907. No. 85480.

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# MARINE AND NAVAL ENGINEERING

**Auxiliary Machinery.**

Auxiliary Machinery on Merchant Steamers. An illustrated description of auxiliary machinery for engine and boiler-room, for draught and ventilation, refrigeration, deck machinery, steering gears, etc. Supplement also. 22500 w. Engr, Lond—June 21, 1907. No. 85403 A.

**Barges.**

Barges for Shipment of Coal and Ore. Illustrations and description of a "bunkering barge" intended for discharging coal directly into the bunkers of a steamer. 800 w. Engng—June 28, 1907. No. 85503 A.

**Battleships.**

French Battleships Republique and Patrie. J. Peltier. Illustrations, description of vessels and equipment, report of trials, and comparison with the American battleship Virginia. 1600 w. Int Marine Engng—Aug., 1907. No. 85905 C.

U. S. S. Kansas. William Ashley Leavitt, Jr. Illustrated description of the vessel and its equipment, with report of official trials. 12500 w. Jour Am Soc of Nav Engrs—May, 1907. No. 85767 H.

**Boilers.**

A New Cylindrical Marine Fire Tube Boiler. Benjamin Taylor. Illustrates and describes the invention of Mr. Inglis, which is designed to increase the efficiency of the "Scotch" boiler, particularly when working under forced draught in a closed stokehold. 800 w. Boiler Maker—July, 1907. No. 85356.

**Cable Steamer.**

The Cable Steamer Ogasawara Maru. S. Oi. Illustrated description of this new Japanese steamer and its equipment. 2500 w. Int Marine Engng—Aug., 1907. No. 85908 C.

**Compasses.**

Compasses on Lake Steamers. Clarence E. Long. Discusses the deviation and changes that make the use of the compass difficult, and methods of verifying or checking the course, giving problems to illustrate Especially explaining the use of Baxter's compass diagram. 3800 w. Marine Rev—July 25, 1907. No. 85965.

**Corrosion.**

Corrosion of Propeller Shaft, U. S. S. Rhode Island. Henry E. Rhoades. Drawing and descriptive account of the condition discovered, with the writer's explanation of the possible cause. 1200 w. Jour Am Soc of Nav Engrs—May, 1907. No. 85763 H.

**Electric Pumping.**

The Application of Electricity to the Driving of Pumping Machinery for Pontoon and Graving Docks. W. C. Mountain. Gives examples of docks driven both by steam and electricity, giving the principal data as regards dimensions, pumping machinery, and the cost of pumping per ton docked. Discussion. Ills. 5500 w. Trans N-E Coast Inst of Engrs & Shipbldrs—June, 1907. No. 85823 N.

**Engines.**

High-Speed Two-Stroke Engines, with Remarks on Internal Water Cooling. T. D. Kelly. Gives descriptions and diagrams showing the evolution of the Duplex two-stroke engine, describing also some improvements which will probably be adopted for large powered marine work. 2800 w. Prac Engr—July 19, 1907. Serial. 1st part. No. 85983 A.

**Ferryboats.**

New Ferryboats for City of New York. Illustrated detailed description of the new screw ferryboat "Bay Ridge," the latest addition to the municipal ferryboats. 1500 w. Naut Gaz—July 25, 1907. No. 85900.

The Long Island Ferryboat Hempstead. Illustrated description of one of two new ferryboats recently placed in service between 34th St., New York, and Long Island City. 1000 w. Int Marine Engng—Aug., 1907. No. 85907 C.

**Fishing Vessel.**

The Oil-Motor Herring-Drifter "Thankful." Illustrated description of a fishing-vessel, fitted with an oil-engine rated at 82 indicated horse-power. 1500 w. Engng—July 5, 1907. No. 85593 A.

**Lighthouses.**

Some New German Lighthouses. Illustrated descriptions of recent types showing the great improvements. 700 w. Engr, Lond—June 8, 1907. No. 85504 A.

**Motor Boats.**

The Development of Motor-Boat Construction with some Examples of the Applications of the Motor Boat in Naval Service (Die Entwicklung des Motorbootbaues mit besonderer Berücksichtigung der Verwendung von Motorbooten in der Kriegsmarine). W. Kaemmerer. Ills. 3000 w. Zeitschr d Ver Deutscher Ing—June 22, 1907. No. 85680 D.

A New Automobile Boat. Jauques Boyer. Brief illustrated description of a self-propelled vehicle, devised by J. Ravaillier, which can navigate in water or travel overland. 500 w. Sci Am—July 20, 1907. No. 85741.

**Naval Science.**

Notes on Naval Science Topics. Arthur R. Liddell. Comments of some of the

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problems in the designing and working of ships, such as proportions, freeboard, etc. 3000 w. Int Marine Engng—Aug., 1907. No. 85911 C.

**Navy Yards.**

The Position and Equipment of the Puget Sound Navy Yard. H. Cole Estep. A study of American naval interests on the Pacific, especially the location and equipment of dry-docks. Ills. 1500 w. Engineering Magazine—Aug., 1907. No. 85918 B.

**Paddle-Steamer.**

Paddle-Steamer "Bassein" for the Burma Railway Company. Illustrates and describes a large side-wheel paddle steamer recently built for steam ferry service on the Irrawaddy. 1000 w. Engng—June 21, 1907. No. 85401 A.

**Repairs.**

Temporary Repairs to Steamer Damaged Abroad. Illustrates and describes temporary repairs made to a ship while off the coast of South America, and nearly 800 miles from the nearest drydock. 1000 w. Prac Engr—July 19, 1907. No. 85982 A.

**Safeguards.**

Electric Safeguards at Sea. A. S. Atkinson. On the electric appliances introduced on modern ships, especially their bearing on fire risks. 2500 w. Int Marine Engng—Aug., 1907. No. 85906 C.

**Salving.**

Notes on Raising the Gunboat Machias. Illustrates and describes methods of raising this steel gunboat which was sunk during a hurricane. 700 w. Int Marine Engng—July, 1907. No. 85352 C.

The Salving of the "Suevic." A. G. Hood. Illustrated description of a difficult engineering feat. 1300 w. R R Gaz —June 28, 1907. No. 85336.

**Shipyards.**

Glimpses into Some German Shipyards. Harold A. Everett. Brief illustrated descriptions of the Vulcan yard, and the Howaldtzwerke, are given in the present number. 2000 w. Int Marine Engng—July, 1907. Serial. 1st part. No. 85353 C.

The Société des Chantiers et Ateliers de la Gironde. Plans and description of this shipbuilding yard almost opposite the Bordeaux commercial docks. 1500 w. Engng—June 21, 1907. No. 85398 A.

**Slips.**

A Simplified Method of Calculating Curved Launching Slips (Vereinfachte Berechnung von Kreisbogenformigen Ablaufsbahnen). Alfred Schwarzenberg. A mathematical paper deducing formulæ for the calculation of launching slips in the form of arcs. Ills. Tables. 2000 w. Schiffbau—June 12, 1907. No. 85644 D.

**Sound Signals.**

Sound Signals for Mariners: An Inventive Field Which Is Not Overworked. C. H. Claudy. Gives an illustrated outline sketch of the field of sound signals for marine use. 1400 w. Sci Am—June 29, 1907. No. 85313.

**Steamships.**

The New Turbine Steamship Creole. Illustrated description of a steamship equipped with Curtis turbines. It is for service between New York and New Orleans. 2000 w. Naut Gaz—July 4, 1907. No. 85431.

The Royal Mail Steam Packet Company's T.-S. S. "Avon." Illustrates and describes this vessel which is intended for the South American mail service. Plates. 700 w. Engng—July 5, 1907. No. 85591 A.

The New Hamburg-American Liner President Lincoln. Illustrated description of this new vessel and the equipment. 1200 w. Int Marine Engng—Aug., 1907. No. 85910 C.

**Torque.**

Torque of Propeller Shafting. J. Hamilton Gibson. Investigations and results. Diagrams. 2800 w. Jour Am Soc of Nav Engrs—May, 1907. No. 85766 H.

**Towing.**

The Automatic Steam Towing Machine. Thomas S. Kemble. Briefly reviews the history of towing machines, discussing their theory and practical operation, and describes the latest type of Chase towing machine. 2500 w. Int Marine Engng—Aug., 1907. No. 85909 C.

**Turbines.**

Marine Steam Turbine Development. Hon. C. A. Parsons and R. J. Walker. Deals with the development, giving particulars and results comparing turbine vessels with other vessels fitted with reciprocating engines. Plates. 6000 w. Trans N-E Coast Inst of Engrs & Shipbldrs—June, 1907. No. 85824 N.

The Marine Steam-Turbine. Hon. C. A. Parsons, and H. Wheatley Ridsdale. Read at meeting of the Inst. of Naval Archts. Discusses practical points in the application of the marine steam turbine: the design, construction, and running. Ills. 4000 w. Engng—July 12, 1907. No. 85874 A.

**U. S. Navy.**

The Vessels and Guns of the Old Navy, 1775-1850. Dr. Charles Oscar Paullin. An illustrated description of the naval vessels of the revolutionary war, and of the war of 1812 and the first half of the 19th century. 2700 w. Sci Am—June 29, 1907. No. 85315.

**Warships.**

Progress of Warships and Machinery Under Construction in England. Reviews the progress of the past six months. 2000 w. Engr. Lond—July 5, 1907. No. 85594 A.

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# MECHANICAL ENGINEERING

## AUTOMOBILES.

**Air Cooling.**

The Present Status of American Air-Cooled Motors (Der Gegenwärtige Stand der Amerikanischen Luftgekühlten Motoren). Alois Riehl. Illustrated description of various types showing present practice in America. 3800 w. Serial. 2 parts. Zeltschl d Mitt Motorwagen-Ver—May 31 and June 15, 1907. No. 85669 each D.

**Benz.**

The 50-H.P. Four-Cylinder Benz Car. The chief features of this powerful machine are illustrated and described. 2000 w. Autocar—June 22, 1907. No. 85375 A.

**Britannia.**

The Britannia Petrol Car. Illustrated description of a new car. 900 w. Auto Jour—July 20, 1907. Serial. 1st part. No. 85979 A.

**Car Testing.**

Wellington's Car Testing Machine. Illustrated description of this machine for testing motor cars, and method of testing. 1200 w. Autocar—July 20, 1907. No. 85981 A.

**Cleaning Plant.**

An Automobile Vacuum Cleaning Plant. An illustrated description of a combined gasoline motor-propelled vacuum cleaner, in which the engine of the vehicle also drives the vacuum apparatus. 1000 w. Sci Am Sup—July 6, 1907. No. 85413.

**Commercial Vehicles.**

Motor Truck of the Roth-Gesellschaft in Schöningen (Motorlastwägen der Roth-Gesellschaft in Schöningen). Herr Pflug. Illustrated detailed description of this car for heavy trucking service. 2200 w. Zeitschr d Mitt Motorwagen Ver—May 31, 1907. No. 85670 D.

**Design.**

The Present Status of the Auotmobile (Ueber den Heutigen Stand unserer Automobile). Hugo Lentz. Considers various points of design and suggests where need for improvement lies. Ills. 4000 w. Zeitschr d Mitt Motorwagen Ver—June 15, 1907. No. 85671 D.

**Engine.**

A Paraffin Motor Car Engine. Illustrated description of a two-cylinder Allsop engine working on the Otto cycle. 700 w. Engr, Lond—June 21, 1907. No. 85404 A.

**Float Chamber.**

The Design of a Float Feed Chamber. Leon Carayol. Describes how the level of the petrol is maintained to avoid overflowing, explaining the theory of the design. Ills. 900 w. Autocar—July 20, 1907. No. 85980 A.

**Gears.**

Electrical Transmission Gears on Motor Vehicles. Alan Archibald Campbell Swinton. Read at Engng. Con. of the Inst. of Civ. Engrs. Briefly describes arrangements adopted. Short discussion. 2000 w. Elec Engr, Lond—June 21, 1907. No. 85383 A.

**Horch.**

The Horch Petrol Cars. Illustrated description of the chief features of these vehicles, built in Saxony. 1200 w. Auto Jour—June 22, 1907. Serial. 1st part. No. 85376 A.

**Junior.**

The Junior 18-24 H.P. and 28-40 H.P. Chassis. Illustrates and describes features of these Italian cars. 1200 w. Autocar—June 29, 1907. No. 85492 A.

**Locomobile.**

The Locomobile Presents Its 1908 Models. Illustrated description of two types, calling attention to new features. 1500 w. Automobile—July 25, 1907. No. 85901.

**Materials.**

Materials for Automobile Construction. Thomas J. Fay. Extract from Chapter I. of a work on this subject. 3300 w. Automobile—July 11, 1907. No. 85509.

**Mercedes.**

The 75 H.P. Mercedes. An illustrated description of the new six-cylinder car. 1000 w. Autocar—July 13, 1907. No. 85854 A.

**Omnibuses.**

Technical Notes on the Motor Omnibuses of London (Technische Betrachtungen über die Londoner Motoromnibusse). Herbert Bauer. Illustrated detailed description of the various types of motor omnibus operating in London. 4000 w. Serial. 1st part. Zeitschr d Mitt Motorwagen Ver—June 15, 1907. No. 85672 D.

The Kriéger Petrol-Electric Motor Omnibus (La Voiture Pétrolés-Electrique, Système Kriéger). F. Drouin. An illustrated description of this motor omnibus in service at Berlin. 2000 w. Génie Civil—June 1, 1907. No. 85613 D.

**Regulations.**

How France Controls Her Automobilists. W. F. Bradley. Information in regard to regulations for owners and operators, system of identification, etc. 1500 w. Automobile—July 4, 1907. No. 85436.

**Steering.**

Types of Automobile Steering Mechanisms. E. J. Bartlett. Discusses their

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comparative merits for various kinds of service, and the principles controlling their design and laying out. Diagrams. 4000 w. Am Mach—Vol. 30, No. 30. No. 85882.

## COMBUSTION MOTORS.

**Furnace Gases.**

The Economical Production of Power from Furnace Gases (Production Economique de la Force Motrice au Moyen des Gaz Métallurgiques). Ch. Dantin. Illustrated description of the power plant of the Cockerill Company at Seraing, Belgium, which utilizes coke-oven and blast-furnace gases. 5000 w. Génie Civil—June 29, 1907. No. 85618 D.

The Use of Excess Gas from By-Product Coke Ovens for Light and Power Purposes. C. E. Rhodes. Gives particulars taken from the actual working results of two batteries of ovens, one with horizontal and the other with vertical flues. 1200 w. Ir & Coal Trds Rev—June 28, 1907. No. 85507 A.

**Gas Engines.**

Some Notes on Gas Engines. Prof H. Diederichs, in *Sibley Jour. of Engng.* Discusses some of the interesting tests and treatises that have appeared in German literature, with data observed by the writer. 19800 w. Jour Am Soc of Nav Engrs—May, 1907. No. 85762 H.

A New Line of Horizontal Engines. Illustrates and describes single cylinders, twin cylinders and cylinders arranged in tandem. 1200 w. Engr, U S A—July 1, 1907. No. 85374 C.

Roots Two-Stroke Cycle. Internal-Combustion Engine. Sectional elevations and description of a new engine patented by J. D. Roots, London. 1500 w. Mech Engr—July 13, 1907. No. 85859 A.

A Notable Tod Gas Engine. Brief illustrated description of an engine installed at the Youngstown, O., works of the Carnegie Steel Company. 800 w. Ir Age—July 18, 1907. No. 85728.

Power from Producer Gas. G. W. Munro. Describes a producer gas engine plant, and gives a report of its efficiency and performance. 3000 w. Purdue Engng Rev—1907. No. 85937 N.

The Gas Power Plant of the Norton Company. An illustrated general outline of the plant, with report of its performance under every-day conditions. 1500 w. Power—July, 1907. No. 85343 C.

A Mammoth Alternating-Current Gas Engine Railway Plant. Describes a San Francisco plant where twin tandem, double-acting engines operating on crude oil water gas are installed. Ills. 1500 w. Engr, U S A—July 15, 1907. No. 85557 C.

**Gas Holders.**

See Civil Engineering, Construction.

**Gas Producers.**

Gas Producers (Ueber Gasgeneratoren). Discussion of Johannes Körting's paper before the Verein Deutscher Eisenhüttenleute and reprinted in *Stahl und Eisen* for May 15, 1907. Ills. 4500 w. Stahl u Eisen—June 5, 1907. No. 85625 D.

Discussion of the Theoretical Performance of Coke Gas Producers (Représentation du Fonctionnement Théorique des Gazogènes au Coke). Rodolphe Soreau. A mathematical explanation of simple means for making calculations in gas producer practice, including composition of gas, calorific power of gas, thermal efficiency of the producer, etc. 3000 w. Mem Soc Ing Civ d France—May, 1907. No. 85602 G.

**Ideal Engine.**

The Ideal Internal-Combustion Engine. E. N. Percy. Outlines an engine embodying the best points of long-tried engines. 1400 w. Power—July, 1907. No. 85342 C.

**Ignition.**

Some Facts Pertaining to Electrical Ignition. Henry G. Chatain. Extract from a paper read before the Soc. of Auto. Engrs., N. Y. Describes tests made to determine the most favorable operating conditions of a Simms-Bosch low-tension magneto. Also gives tests of some high-tension coils. Diagrams. 1200 w. Automobile—July 18, 1907. No. 85768.

**Lubrication.**

The Lubrication of Petrol Engines. J. Veitch Wilson. Deals with the various methods adopted for the application of lubricants and adaptability of the lubricants to these different methods. 1300 w. Autocar—July 6, 1907. Serial. 1st part. No. 85578 A.

**Natural Gas.**

Natural Gas Plant of Art Metal Construction Co. Illustrated description of a power plant at Jamestown, N. Y., having two twin and one large tandem unit, the latter controlled by a flywheel governor, all running on natural gas. 3000 w. Engr, U S A—July 15, 1907. No. 85558 C.

**Oil Engines.**

A Large Oil Engine Plant. Oil engines run in parallel on a power and lighting load at the works of the Ball Bro.'s Glass Mfg. Co., Muncie, Ind. Ills. 2500 w. Engr, U S A—July 15, 1907. No. 85561 C.

**Peat-Alcohol.**

Alcohol from Peat. Briefly describes the nature of certain processes for the extraction, on a large scale and at a low cost, of alcohol from peat. Also considers the possibility of utilizing this fuel. 3000 w. Auto Jour—July 20, 1907. No. 85978 A.

**Producer Plants.**

An Interesting Suction Gas Producer Plant. Illustrated description of anthracite producers installed in a factory in

Cleveland, O., for which the exhaust of the engine is utilized in making steam. 2200 w. Engr, U S A—July 15, 1907. No. 85560 C.

Producer Plant of the John Thompson Press Co. Godfrey M. S. Tait. This plant in Long Island City, N. Y., is illustrated and described in detail. 2000 w. Engr, U S A—July 15, 1907. No. 85559 C.

**Water Gas.**

The Value of Water Gas (Zur Bewertung des Wassergases). Franz Schäfer. A criticism of Herr Kayser's article in *Gesundheits-Ingenieur* for April 6, 1907, taking exception to many of the latter's statements as to the value of water gas for heating, lighting and power purposes. 2500 w. Gesundheits-Ing—June 22, 1907. No. 85654 D.

## HEATING AND COOLING.

**Car Heating.**

A Method of Ventilating and Heating Railroad Cars. Drawings and description of E. R. Swan's idea of a proper method of warming and ventilating railroad cars. 1400 w. Met Work—July 6, 1907. No. 85406.

**Central Plants.**

Heating and Ventilating a Group of Public Schools. Samuel R. Lewis. Read before the Am. Soc. of Heat. & Vent. Engrs. Plans and description of a plant in Galesburg, Ill., which furnishes steam heat, electric current for lighting and power, and compressed air for various purposes, to three school buildings located on the same block. 1800 w. Heat & Vent Mag—July, 1907. No. 85828.

Results of Operation of the Municipal Central Heating and Electric Plant at Dresden (Ueber die Betriebsergebnisse des Kgl. Fernheiz- und Elektrizitätswerkes zu Dresden). R. Trautmann. Paper read before the Convention of Heating and Ventilating Engineers at Vienna, 1907. Gives costs and details of operating a central plant for heating and lighting a group of municipal buildings. Ills. 4000 w. Gesundheits-Ing—June 2, 1907. No. 85652 D.

**Dwellings.**

The Heat Absorption and Transmission of the Outer Walls of Buildings (Wärmeaufnahme und -abgabe der Umfassungswände von Gebäuden). G. de Grahl. Paper read at the Convention of Heating and Ventilating Engineers at Vienna, 1907. Refers principally to dwelling houses and gives numerous diagrams, curves, and tables. 7500 w. Gesundheits-Ing—June 2, 1907. No. 85651 D.

**Electric.**

Electric Cooking and Heating in Hotels. An illustrated account of two heating and cooking installations of considerable size in Switzerland, giving details of apparatus used. 2000 w. Elect'n, Lond—July 19, 1907. No. 85986 A.

**Gas.**

The Testing and Hygienic Efficiency of Gas Fires. Jno. H. Brearley. Read before the Inst. of Gas Engrs. An account of the tests made by the writer for radiation, for heat convection, and for carbon monoxide. 4500 w. Engr, Lond—July 12, 1907. No. 85876 A.

**History.**

The History of Heating Engineering up to the Year 1870 (Aus der Geschichte der Zentralheizungs-technik bis zum Jahre 1870). Hermann Vetter. Paper read at the Convention of Heating and Ventilating Engineers at Vienna, 1907. An exhaustive historical review of heating methods prior to 1870. Ills. 15000 w. Gesundheits-Ing—June 2, 1907. No. 85650 D.

**Hospitals.**

The Heating and Ventilating of Hospitals (Heizung und Lüftung in Krankenhäusern). H. Rietschel. Paper read before the Convention of Heating and Ventilating Engineers at Vienna, 1907. Discusses the peculiar problems in hospital heating and ventilating. 5000 w. Gesundheits-Ing—June 8, 1907. No. 85653 D.

Heating and Ventilating a Hospital in New York. A notable example, in which air is distributed from a large plenum chamber and heated in a solarium by hot water from steam, is illustrated and described. The Willard Parker hospital. 3500 w. Met Work—July 6, 1907. No. 85405.

**Hotel.**

Heating and Ventilating the Hotel Knickerbocker, New York City. Illustrates and describes the mechanical equipment for this fine hotel, at Broadway and 42d St. 3800 w. Eng Rec—July 13, 1907. No. 85541.

**Refrigeration.**

The Present Condition of the Refrigeration Industry (Etat Actuel de l'Industrie Frigorifique). Ch. Lambert. An exhaustive review of the industrial applications of refrigeration, the methods and machines used, and the theories involved in its development. Ills. Tables. 32000 w. Mem Soc Ing Civ d France—April, 1907. No. 85600 G.

The Value of the Indicator in Refrigeration Work. Dr. Joseph H. Hart. Its usefulness shown by analogy to steam-engine practice. Discusses the standard diagram and its meaning in compression. 3000 w. Engineering Magazine—Aug., 1907. No. 85919 B.

Electric Refrigeration in a Wholesale Produce House. Illustrates and describes

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an example of the use of automatic electric refrigeration in Lowell, Mass. 800 w. Elec Wld—July 6, 1907. No. 85486.

**Steam Heating.**

The Combined Pressure and Vacuum System of Steam Heating. George D. Hoffman. Read before the Am. Soc. of Heat. & Vent. Engrs. Presents the advantages claimed for this new system of vacuum steam heating. 2500 w. Heat & Vent Mag—July, 1907. No. 85829.

A New Method in Vacuum Heating. A brief description of an improvement and a statement—the advantages of compounding heating coils to save steam. 1500 w. Engr, U S A—July 1, 1907. No. 85373 C.

Heating and Ventilating the Budapest Stock Exchange. Charles Knuth. From a paper read before the Inst. of Heat. & Vent. Engrs. at Windsor, Eng. Gives a detailed explanation of steam pipe size determinations, and other features of the system installed. 2800 w. Met Work—July 13, 1907. No. 85500.

## HYDRAULICS.

**Pumping.**

Pump Slippage. Alba L. Holmes. Gives results of tests made for slippage, and troubles due to it. Short discussion. 2700 w. Pro Am Water Wks Assn—1906. No. 85810 N.

**Turbines.**

Recent High-Speed Turbines (Neuere Schnelläufer-Turbinen). V. Graf and D. Thoma. Illustrates and describes improved water turbines in both Europe and America, giving efficiency curves, etc. 4000 w. Zeitschr d Ver Deutscher Ing—June 29, 1907. No. 85681 D.

The Lorenz Turbine Theory (Zur Lorenzschen Theorie der Kreiselräder). W. Bauersfeld. A mathematical paper taking exception to some of the conclusions reached by Dr. Lorenz. 2500 w. Zeitschr f d Gesamte Turbinenwesen—June 20, 1907. No. 85643 D.

Speed Regulation of High Head Water Wheels. H. E. Warren. Considers in detail the special features in the development of water power under high heads and the methods of control. Ills. 6000 w. Tech Qr—June, 1907. No. 85719 E.

**Units.**

A New Hydraulic Unit. Daniel W. Mead. Brief explanation of the "cylinder inch" and its use. 500 w. Pro Am Water Wks Assn—1906. No. 85812 N.

## MACHINE WORKS AND FOUNDRIES.

**Arbors.**

Making an Accurate Arbor. Harry A. S. Howarth. Describes method. Ills. 1000 w. Mach, N Y—July, 1907. No. 85484 C.

**Ball Bearings.**

Elimination of Friction in Ball Bearings. J. F. Springer. Analyzes the sources of friction, showing the importance of this question in view of the application of such bearings in heavy work. Ills. 2000 w. Am Mach—Vol. 30, No. 30. No. 85883.

**Brass Casting.**

Regulations for the Casting of Brass. Gives draft of regulations proposed in substitution for the special rules now in force. 1000 w. Engr, Lond—July 5, 1907. No. 85596 A.

**Brass Refuse.**

The Treatment of Brass Foundry and Brass-Rolling Mill Refuse. Erwin S. Sperry. An illustrated description of methods in use to prevent abnormal waste in brass mills. Describes the "Hill Barrel" and its use, washing methods, treatment of slags, skimmings, sweeps, etc. 4500 w. Brass Wld—July, 1907. No. 85825.

**Case Hardening.**

Chemical and Metallographical Researches on Case Hardening (Chemische und Metallographische Untersuchungen des Hartgusses). H. Wedding and Fritz Cremer. A report of an exhaustive investigation of the changes in composition and structure of steel during the case-hardening process. Ills. Serial. 1st part. 3000 w. Stahl u Eisen—June 12, 1907. No. 85627 D.

**Castings.**

An Interesting Molding-Machine Job. Robert Patten. Showing how nine different castings can be produced from one machine, by making a few alterations in its set-up. Ills. 1800 w. Am Mach—Vol. 30, No. 29. No. 85778.

Cast Thread Fittings. Henry B. Cutler. Read before the Am. Found. Assn. Brief account of the principles and method of making gray iron castings with threads cast in them. 700 w. Foundry—July, 1907. No. 85745.

**Chips.**

Why Chips Cling to Screw-Machine Tools. C. L. Goodrich. Shows how improper clearance, incorrect rake, excessive speed, etc., cause the chips to heat and weld to the cutting edges of tools. Ills. 1200 w. Am Mach—Vol. 30, No. 30. No. 85881.

**Copper.**

Copper for the Foundry. F. L. Antisell. Read before the Am. Found. Assn. Discusses points the buyer should consider, such as brand, conductivity, analysis, shape, etc. 1500 w. Foundry—July, 1907. No. 85748.

**Cupolas.**

Comparative Cupola Practice. W. S. McQuillan. Read before the Am. Found. Assn. Gives tabulated results from a number of foundries, comparing results

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and giving conclusions. 1700 w. Foundry—July, 1907. No. 85747.

**Cutters.**

The Fly Cutter in Punch and Die Work. Describes an original method of producing complex shapes by a system of elementary cutters and milling-machine adjustments. Ills. 1600 w. Am Mach—Vol. 30, No. 30. No. 85880.

**Dials.**

Making a Set of Accurate Index Dials. F. A. Stanley. Explains how a set of seven index dials was originated with the aid of some accurate fixtures. Ills. 4500 w. Am Mach—Vol. 30, No. 28. No. 85565.

**Fluxes.**

Foundry Fluxes or Deoxidants. Walter J. May. Suggestions for fluxing iron, copper alloys, and other metals. 700 w. Prac Engr—June 28, 1907. No. 85493 A.

**Fly-Wheels.**

Size, Weight and Capacity of Fly-Wheels for Punches. Frank B. Kleinhaus. Gives a method of determining the size, weight and capacity of a fly-wheel to punch a given size hole through a given thickness of metal. Ills. 2500 w. Mach, N Y—July, 1907. No. 85482 C.

**Foundries.**

Foundry Design. F. A. Coleman. From a paper read before the Am. Found. Assn. Discusses the requirements and form of construction best adapted to secure desired results. 3500 w. Ir Age—July 11, 1907. No. 85481.

The Foundries of the Atlas Engine Works, Indianapolis. Brief illustrated descriptions of the light and heavy work foundries. 1200 w. Ir Trd Rev—July 11, 1907. No. 85526.

**Furnaces.**

The Oil Furnace vs. the Sheeler-Hemsher Improved Crucible Furnace. W. H. Kane. Read before the Am. Found. Assn. On the development of the Sheeler-Hemsher forced draft crucible furnace. 1500 w. Found—July, 1907. No. 85749.

**Galvanizing.**

Galvanizing by the Zinc Bath and Electrolytic Methods (Zingage à Chaud et Galvanisation Electrolytique). A comparison of the two methods as to economy and efficiency, showing the electrolytic method to be greatly superior. 2000 w. Métallurgie—June 19, 1907. No. 85611 D.

**Green Gold.**

Green Gold Deposits and How They Are Produced. Explains methods of plating, giving solutions for light green, and for dark green deposits. Ills. 1200 w. Brass Wld—July, 1907. No. 85827.

**Grinder.**

5 x 48-Inch Automatic Sizing Grinder. Illustrated description of a machine having an electrically controlled feed and sizing device for enabling duplicate work to be automatically ground. 2800 w. Am Mach—Vol. 30, No. 27. No. 85463.

**Machine Tools.**

Machine Tools in a Concrete Machine Shop. L. P. Alford. Deals with the arrangement of departments and methods of setting machine tools in the buildings of the United Shoe Machinery Company. Ills. 3000 w. Am Mach—Vol. 30, No. 27. No. 85461.

Some Recent Developments in Machine Tools. Joseph Horner. Calls attention to some recent improvements in design, and illustrates and describes some of the later machines. 5000 w. Cassier's Mag—July, 1907. Serial. 1st part. No. 85714 B.

**Metallography.**

The Uses of Microscopic Metallography in Industry (L'Utilisation Industrielle de la Métallographie Microscopique). Léon Guillet. Describes the method of preparing and examining specimens and outlines what may be learned through the microscopic study of steels, brass, bronze, and other alloys. Ills. Serial. 2 parts. 7000 w. Génie Civil—June 15 and 22, 1907. No. 85617 each D.

**Molding.**

Plate Molding—A Three-Part Piece Made in a Two-Part Flask. G. Buchanan. Illustrated description of method. 500 w. Am Mach—Vol. 30, No. 29. No. 85776.

The Universal System of Machine Molding. E. Ronceray. Read before the Am. Found. Assn. Describes a French method for the manufacture of pattern and stripping plates in the foundry instead of the machine shop. Ills. 3000 w. Foundry—July, 1907. No. 85746.

**Molds.**

Steel Molds for Casting Small Parts. Charles Petitjean. Illustrates two examples of this work and gives a description of each. 900 w. Am Mach—Vol. 30, No. 28. No. 85569.

**Nurls.**

Making Nurls. E. A. Dixie. Illustrates and describes methods used. 1000 w. Am Mach—Vol. 30, No. 27. No. 85462.

**Riveters.**

Improvements on Compressive Riveters. Chester B. Albree. Illustrating and describing the advances that have been made in riveters for concrete mixers and a new type of boiler riveter. 2200 w. Am Mach—Vol. 30, No. 28. No. 85568.

**Riveting.**

How to Heat and Drive Steel Rivets. T. C. Best. Third prize in the Champion contest. Considers various methods of driving steel rivets, with a view to making them tight. 6500 w. Boiler Maker—July, 1907. No. 85355.

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**Screws.**

Lead and Pitch of a Screw—What They Are. Oscar J. Beale. Explains these terms as used by Brown & Sharpe. 1400 w. Am Mach. Vol. 30, No. 29. No. 85777.

**Shears.**

Recent Plate Shears (Ueber neuere Blechsheren). Illustrated description of recent shearing machines for heavy service, operated by electricity and water power. 2000 w. Stahl u Eisen—June 19, 1907. No. 85628 D.

**Shops.**

Planning the Work in a Shop. S. H. Bunnell. Suggestions for foremen showing the value of a system. 1500 w. Am Mach—Vol. 30, No. 28. No. 85567.

Stamp End Works, Lincoln. An illustrated article describing notable improvements recently effected at these English works. Plate. 4000 w. Engng—June 21, 1907. No. 85399 A.

General Concrete Machine Shop Equipment. L. P. Alford. Illustrates and describes the equipment of buildings other than those devoted to manufacturing purposes, in the plant of the United Shoe Machinery Co., Beverly, Mass. 2200 w. Am Mach—Vol. 30, No. 29. No. 85775.

**Soldering.**

Soldering and Soldering Processes. The form of solders and the process of soldering are discussed. 2200 w. Sci Am Sup—July 6, 1907. No. 85415.

**"Verde-Antique."**

The Rapid Production of the "Verde-Antique" Finish; and the Method of Obtaining the Various Shades. Information and directions for producing this finish. 3000 w. Brass Wld—July, 1907. No. 85826.

**Welding.**

Autogenous Welding of Metals. Ernest Schneider. Abstract translation of a paper read in Chemnitz, Germany. Describes applications of the oxy-hydrogen and oxy-acetylene flames. 3000 w. Sci Am Sup—July 20, 1907. No. 85743.

Oxy-Acetylene Blowpipe Welding. W. H. Booth. Explains the use of this method in making reinforced tubes for automobile work, its possibility for boilers and reasons for its intense heat. Ills. 2000 w. Am Mach—Vol. 30, No. 28. No. 85566.

**Wire Drawing.**

The Heating of Charges for Wire Drawing (Die Erwärmung eines Drahtformigen Schmelzeinsatzes). Fritz Emde. A theoretical and mathematical discussion of the subject. Ills. 6000 w. Serial. 2 parts. June 16 and 23, 1907. No. 85661 each D.

Rubber Covered Wire.—Its Manufacture and Tests in Regard to Its Life and Insulation Properties. Hugh T. Wreaks. Gives an outline of the manufacture of low-voltage rubber covered wire, showing the possibilities of adulteration, and the difficulty of detection. Ills. Discussion. 7500 w. No. 68. Pro Brooklyn Engrs' Club—1906. No. 85974 N.

## MATERIALS OF CONSTRUCTION.

**Alloy Steels.**

Nickel-Chrome Steel. E. F. Lake. Explains the effect of chromium, of silicon, of manganese, of phosphorus and sulphur, the heat treatment, machinery, etc. 2500 w. Mach, N Y—July, 1907. No. 85485 C.

Properties and Uses of Vanadium Steel. Extracts from a lecture by J. Kent Smith before the Assn. of Automobile Mfrs., New York. 3500 w. Ir Trd Rev—July 11, 1907. No. 85527.

**Automobiles.**

See Mechanical Engineering, Automobiles.

**Lubricants.**

The Selection of a Proper Lubricant. Roger B. Whitman. Information in regard to lubricants and methods of testing, with suggestions for the selection of an oil. 1600 w. Automobile—July 11, 1907. No. 85510.

**Steel.**

Steel as an Engineering Material. William Stuart Standiford. Describes steel made by the crucible, open-hearth, and Bessemer processes discussing its quality, uses, etc. 2000 w. Ry & Loc Engng—July, 1907. No. 85427 C.

The Use of High-Tensile Steel. Gives three papers dealing with high-tensile steel in various departments of engineering construction, with discussion. The papers of A. E. Seaton, Edwin William De Russett, and Alfred Fernandez Yarrow, presented at the Engineering Conference. 6000 w. Ir & Coal Trds Rev—June 28, 1907. No. 85508 A.

**Wastes.**

The Systematic Treatment of Metalliferous Waste. L. Parry. The present article discusses the general economic principles, the valuation of various waste products, and the sources of supply. 3000 w. Min Jour—July 6, 1907. Serial. 1st part. No. 85587 A.

## MEASUREMENT.

**Color Meter.**

A New Color Meter. Frederic E. Ives. Describes a direct vision instrument with all the operating adjustments controlled by screws a few inches from the eye, and its operation. 3500 w. Jour Fr Inst—July, 1907. No. 85703 D.

**Dynamometer.**

Something New in the Measure of Power. Illustrates and describes a piece of apparatus which, while retaining the

conveniences of the electric motor as a source of power in power tests, gives the power measurements directly. 700 w. Am Mach—Vol. 30, No. 27. No. 85460.

**Gas-Calorimeter.**

Beasley's Recording Gas-Calorimeter. Illustrated detailed description of a new form of calorimeter giving the low-value calorific power. 2000 w. Engng—July 12, 1907. No. 85871 A.

**Torsometers.**

Torsometers. Archibald Denny. Read before the Inst. of Naval Archts. Deals with torsometers as applied to the measurements of power in turbines and reciprocating engines. Ills. 2200 w. Jour. Am Soc of Nav Engrs—May, 1907. No. 85765 H.

**Weighing Machines.**

Automatic Coin-Weighing Machines. A. L. Lambert. Illustrated description of one of the new machines made at the machine shops of the Philadelphia mint. 1200 w. Am Mach—Vol. 30, No. 27. No. 85464.

## POWER AND TRANSMISSION.

**Air Compression.**

The Antecooler, the Intercooler, and the Aftercooler. Frank Richards. Information concerning these useful devices in air compression. 1500 w. Compressed Air—July, 1907. No. 85898.

**Air Compressors.**

The New Franklin Air Compressor. Illustration, with description. 1500 w. Foundry—July, 1907. No. 85751.

The Most Suitable Motive Power for Compressors (Zur Frage des Zweckmässigsten Antriebs für Kompressoren). Fr. Harth. A detailed analysis of the costs of driving an air compressor by steam and by electric power. Ills. 3300 w. Glückauf —June 29, 1907. No. 85634 D.

**Belt Tightening.**

Power Transmission by Artificially Tightened Belts, Particularly the "Lenix" System (Sur la Transmission par Courroie à Tension Artificielle, en particulier le Système "Lenix"). P. Daubresse. Paper read before the International Congress at Liége, 1905. Describes various systems of belt tighteners with mathematical discussion of their design. Ills. 9500 w. L'All Indus—June, 1907. No. 85612 D.

**Chain Driving.**

The Morse Chain on Cone Sprockets. Illustrates and describes a mechanical device forming a substitute for cone pulleys and belts and for gear boxes for main drives. 1000 w. Am Mach—Vol. 30, No. 29. No. 85773.

**Coal Handling.**

Coal and Coke Handling at the Astoria Light, Heat & Power Co.'s Plant, Astoria, L. I. Alfred Kauffmann. Illustrated description of this installation. 1500 w. Eng News—July 11, 1907. No. 85574.

**Cranes.**

Vertical vs. Horizontal Cranes: A Comparison. An investigation of the special advantages and applications of each. Ills. 1800 w. Prac Engr—July 12, 1907. No. 85855 A.

Machinery of the 150-Ton Hammer-Head Crane at Clydebank. Illustrated detailed description of this electric crane at the shipbuilding yard at Clydebank. 2 plates. 3500 w. Engng—June 21, 1907. No. 85400 A.

Electric Freight-Handling Cranes for the Panama Railway. Illustrated description of cranes for the La Boca pier of the Pacific terminal. Designed to operate in a narrow space and to provide for a tidal variation of 20 ft. 500 w. Eng News—July 25, 1907. No. 85886.

Special Derricks and Buckets for the Construction of a Reinforced-Concrete Warehouse at Chicago. Illustrated description of a steel derrick with 135-ft. mast and 85-ft. boom. Also a dumping bucket of special design. 1600 w. Eng News—July 25, 1907. No. 85884.

**Dock Machinery.**

Machinery for Mercantile Ports (Attrezzatura dei Porti Mercantili). A. Gullini. Illustrated description of dock machinery, cranes, etc., exhibited at the Milan exposition, 1906. Serial. 1st part. 1600 w. Monit Tech—June 10, 1907. No. 85621 D.

Dock Equipment; Including the Relative Advantages of Electric and Hydraulic Appliances. W. W. Squire. Read at Engng. Con. of the Inst. of Civ. Engrs. Considers appliances for the handling of cargo. Discussion. 2700 w. Elect'n, Lond—June 21, 1907. No. 85391 A.

Electric Transporters at Mersey Dock. Illustrations and brief description of transporters designed for the rapid handling of general cargo, and to run along the shed-roofs. 500 w. Engng—July 5, 1907. No. 85590 A.

**Elevators.**

The Elevator and Escalator Equipment of the New York Subway. Illustrated description of arrangements for handling large crowds, using the power from the subway. 2500 w. Eng Rec—July 20, 1907. No. 85790.

Electric v. Hydraulic Lifts. Percy Good. A criticism of statements in a recent pamphlet published by the London Hydraulic Power Co., dealing with the comparative safety, convenience, and economy of the two forms of lift-driving. 1500 w. Elec Rev, Lond—July 5, 1907. No. 85582 A.

**Power Plant.**

Power Plant of the West Street Building, New York City. Illustrated detailed description of the mechanical plant in-

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stalled in a 23-story, steel-cage office building, on the Hudson River front. 4500 w. Eng Rec—July 27, 1907. No. 85946.

**Winches.**

The Lidgerwood Electric Friction-Driven Winches for Car Ferries. Illustrated detailed description. 1700 w. Eng News—July 11, 1907. No. 85575.

## STEAM ENGINEERING.

**Boiler Management.**

Boiler, Engine and Generator Testing and Management. Charles L. Hubbard. The present number considers the management of steam boilers. 3000 w. Elec Rev, N Y—July 13, 1907. Serial. 1st part. No. 85532.

Boiler Plant Economy. C. H. Hurd. Discusses the advantage of a system of records, the choice of fuels, boiler room methods, etc. 3000 w. Pro Am Water Wks Assn—1906. No. 85814 N.

**Boilers.**

Steam Boilers. Traces the evolution of heat and its influence on the heating surfaces. 900 w. Prac Engr—July 12, 1907. Serial. 1st part. No. 85856 A.

Boiler Efficiencies. Editorial on the experiments now being conducted by the boiler division of the United States Geological Survey fuel-testing plant at St. Louis, Mo. 800 w. R R Gaz—July 12, 1907. No. 85513.

Arch Tubes and Brick Arches. G. W. Bennett. Gives results of a recent test made with a wide fire-box type of boiler to ascertain the efficiency of the brick arch and arch tubes, describing the test. 2000 w. Boiler Maker—July, 1907. No. 85358.

Capacities of Cast-Iron Sectional Boilers. Kenneth Gray. Read before the Inst. of Heat. & Vent. Engrs. An examination of things affecting boiler capacity, discussing also its efficiency and working qualities. 3000 w. Archt, Lond—June 28, 1907. No. 85489 A.

Waste Heat Boilers for Copper Smelting Furnaces. Plan and description of an interesting installation at a smelting plant at Butte, Montana, for the utilization of waste heat. 1200 w. Eng Rec—July 6, 1907. No. 85457.

See also Marine and Naval Engineering, and Railway Engineering, Motive Power and Equipment.

**Combustion.**

Efficiency in the Burning of Fuel Under the Steam Boiler. William D. Ennis. This third article of a series considers the modifications of draft required by commercial fuels. 3000 w. Engineering Magazine—Aug., 1907. No. 85917 B.

**Feed Water.**

How Should the Feed Water Be Heated? A. J. Albright. A discussion of the best known methods; and formula for calculating the saving by heating with exhaust steam. 2800 w. Power—July, 1907. No. 85348 C.

**Fly-Wheels.**

Inexpensive Devices for Prevention of Fly-Wheel Wrecks. E. E. Clock. Illustrates three devices which can be installed at small cost. 700 w. Power—July, 1907. No. 85346 C.

**Fuels.**

Some Comparative Fuel Values. P. N. Evans. Briefly considers solid, liquid, and gaseous fuels. 1500 w. Purdue Engng Rev—1907. No. 85938 N.

Changing from Wood Fuel to Crude Oil. J. E. Anderan. Describes and illustrates the change by which a saving of $12.90 every 24 hours was made possible. 900 w. Power—July, 1907. No. 85347 C.

Heat Production and the Constituents of Coal. S. W. Parr. Considers the varying proportions of combustible elements present and how they affect the heat value of the fuel. 2800 w. Eng & Min Jour—June 29, 1907. No. 85334.

**Fuel Tests.**

A Review of the United States Geological Survey Fuel Tests Under Steam Boilers. L. P. Breckenridge. Also discussion. 19600 w. Jour W Soc of Engrs—June, 1907. No. 85723 D.

**Lubricating Oils.**

Lubricating Oils (Les Huiles à Graisser). Ch. Baron. Outlines the characteristics of a good lubricating oil, particularly for use in engine cylinders, with description of methods and apparatus for testing. Curves and tables. 2500 w. Mem Soc Ing Civ d France—May, 1907. No. 85601 G.

**Lubrication.**

The Lubrication of High-Speed Machinery (Die Schmierung Schnellaufender Maschinen). K. Lenz. Describes methods used for lubricating journals, crossheads, pistons, eccentrics, etc. Ills. 6500 w. Zeitschr d Ver Deutscher Ing—June 1, 1907. No. 85675 D.

**Pumping Costs.**

Comparative Cost of Pumping by Steam, Internal-Combustion Engines, and Electricity, Based Upon Actual Working. Charles Hawksley and Henry Davey. Read before the Engng. Con. of the Inst. of Civ. Engrs. Short discussion. 1500 w. Elec. Engr, Lond—June 21, 1907. No. 85382 A.

**Pumping Engines.**

New Pumping Engines of the Hamburg Water Works (Neuere Pumpmaschinen des Hamburger Wasserwerkes). Rud. Schröder. A well-illustrated description of these large pumping engines with details of their operation, coal and steam

consumption, efficiency, etc. 4000 w. Serial. 1st part. Zeitschr d Ver Deutscher Ing—June 15, 1907. No. 85677 D.

Most Efficient Ratio of Steam Cylinders in Direct-Acting Compound Pumps. F. F. Nickel. Mathematical discussion, illustrating by examples. 700 w. Power—July, 1907. No. 85345 C.

**Steam Plant.**

A One Hundred Horse-Power Steam Plant. Descriptions of such plants by James F. Hobart, M. B. Godfrey, and C. R. McGahey. Ills. 7500 w. Power—July, 1907. No. 85340 C.

**Superheating.**

Superheated Steam. Thomas Sugden. Read before the South Wales Inst. of Engrs. On the properties of saturated and superheated steam, specific heat, losses, volume, efficiency, economy, etc. 3000 w. Mech Engr—June 29, 1907. Serial. 1st part. No. 85494 A.

**Turbines.**

The Steam Turbine. Charles Proteus Steinmetz. Explains the principles of the impulse turbine and the reaction turbine, and the problem of developing the steam turbine. Ills. 4000 w. Cassier's Mag—July, 1907. No. 85712 B.

Remarks on Impulse Steam Turbines (Einiges über Aktionsdampfturbinen). Felix Langen. A mathematical discussion of friction in impulse turbines to determine the most efficient design. 3000 w. Zeitschr f d Gesamte Turbinenwesen—June 20, 1907. No. 85642 D.

Steam Turbine Theory (Zur Theorie der Dampfturbine). A. Stodola. A mathematical paper discussing, in the first instalment, the influence of variations in speed on the distribution of pressure and on steam consumption. Ills. Serial. 1st part. 4000 w. Zeitschr f d Gesamte Turbinenwesen—June 10, 1907. No. 85641 D.

Steam Turbines and Central Stations (Las Turbinas de Vapor y las Centrales Eléctricas). Emilio Guarini. A review of the development of the steam turbine and a discussion of its use in generating electric power. 5000 w. La Ingenieria—May 30, 1907. No. 85693 D.

See also Marine and Naval Engineering.

**Turbine Testing.**

An Oil Fired Boiler for Testing Steam Turbines. F. W. Feiker. Illustrated description of a system well adapted for varying loads. 1000 w. Engr, U S A—July 1, 1907. No. 85372 C.

**Valves.**

Fitting a Throttle Valve. Suggestions for the careful grinding of the valve and the fitting of the throttle rod and attachments. 800 w. Ry & Loc Engng—July, 1907. No. 85429 C.

**Water Hammer.**

The Principal Investigations of Water Hammer, with Especial Reference to Those of Prof. N. Joukovsky (Notice sur les Principaux Travaux Concernant le Coup de Bélier et Spécialement sur le Mémoire et les Expériences du Prof. N. Joukovsky, 1898). M. Goupil. A historical, mathematical review of the theory of water hammer. Ills. 8000 w. Ann d Ponts et Chaussées—Part I, 1907. No. 85604 E + F.

# MINING AND METALLURGY

## COAL AND COKE.

**Blasting.**

Shot-Firers, and Evils of Solid Shooting. George Harrison. Remarks on the importance of removing the cause of danger, solid shooting, and the effect of large quantities of powder on some coals. 1400 w. Eng & Min Jour—July 27, 1907. No. 85956.

**Coal Washing.**

Process of Coal Washing. Samuel Diescher. States the impurities found in coal, and gives the theory of the process of washing, illustrating and describing various devices used, and giving information relating to their operation. 5500 w. Pro Engrs' Soc of W Penn—June, 1907. No. 85720 D.

Modern Methods of Washing Bituminous Coal. Floyd W. Parsons. Explains how washing has made possible the mining of coal containing impurities, and illustrates and describes a modern washing plant. 1500 w. Eng & Min Jour—July 6, 1907. No. 85451.

Description of Washing Plants in Operation. W. G. Wilkins. Describes complete washing plants, including not only the washing machines, but also the breaking, crushing, and coal-handling plants. Discussion. Ills. 4500 W. Pro Engrs' Soc of W Penn—June, 1907. No. 85721 D.

**Coke Drawing.**

New Machine for Drawing and Loading Coke. W. M. Nixon. Describes a new device which employs drags or hooks of the usual form operated by means of wire rope and winding drums. 3000 w. Eng & Min Jour—July 20, 1907. No. 85844.

**Coke-Oven Gases.**

See Mechanical Engineering, Combustion Motors.

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**Deep Mining.**

The Atchison Mine at Atchison, Kansas. C. M. Young. A brief illustrated description of the deepest bituminous coal mine in the United States. A three-foot bed worked longwall. 1600 w. Mines & Min—July, 1907. No. 85420 C.

**Electricity.**

Alternating Current in Coal-Mining Operations. George R. Wood. Considers the advantages of this system, costs of installation and operation, equipment of a central plant, and illustrates and describes recently installed plants. 4000 w. Eng & Min Jour—July 6, 1907. No. 85448.

Some Recent Improvements in the Design of Electric Cables for Collieries. G. G. L. Preece. Read before the Manchester Geol. & Min. Soc. Illustrates and describes the stranded copper conductor, and a new type of cable called "the patent solid three-core bitumen cable." Discussion. 2200 w. Elec Engr, Lond—June 21, 1907. No. 85386 A.

**Electric Plants.**

Electric Installation at the Cambrian Collieries, Limited. Illustrated detailed description of a plant where electricity has been recently introduced. 2000 w. Col Guard—July 12, 1907. No. 85869 A.

Electric Power Plant at the Cambrian Collieries. Describes the electric plant installed to furnish power for these collieries in South Wales. 1800 w. Engr, Lond—July 5, 1907. No. 85597 A.

**Fire Bosses.**

Proposed Methods for Supervising Fire Bosses (Vorschläge zur Ueberwachung der Tätigkeit der Wettermänner). Herr Baum. A discussion of the necessity of keeping a strict watch over the fire bosses in coal mines in view of the numerous accidents due to inattention and neglect of duty. Ills. 3500 w. Glückauf—June 22, 1907. No. 85633 D.

**Mine Examination.**

Examination of a Large Coal Property in the West. Arthur Lakes. Suggestions for preliminary work to determine the value of property. Ills. 1000 w. Min Wld—July 27, 1907. No. 85967.

**Mine Gases.**

The Causes of Sudden Outbreaks of Gas (Zur Theorie der Plötzlichen Gasausbrüche). Alois Becker. A discussion of the causes of sudden outbreaks of gas in coal mines, evolving a theory based on the accompanying phenomena and supported by numerous examples. 2000 w. Serial. 1st part. Oesterr Zeitschr f Berg u Hüttenwesen—June 1, 1907. No. 85636 D.

**Mine Inspection.**

Coal Mines Inspection in 1906. Digest of the reports of H. M. Inspectors of Mines. 34000 w. Col Guard—July 19, 1907. (Supplement) No. 85989 A.

**Mining.**

Mining Coal. Lee C. Moore. Gives some of the details of operation of a company producing more than 17,000,000 tons of coal per annum. General discussion. 6000 w. Pro Engrs' Soc of W Penn—June, 1907. No. 85722 D.

Working Flat and Pitching Anthracite Seams. M. S. Hachita. Illustrates and describes methods of development. 2500 w. Eng & Min Jour—July 6, 1907. No. 85453.

**New Mexico.**

New Development of Coalfields of New Mexico. Edward K. Judd. An illustrated article giving information in regard to the deposits, mine operations, water supply, etc. 1200 w. Eng & Min Jour—July 6, 1907. No. 85449.

**Pipe Lines.**

Wood versus Iron for Pipe Lines in Coal Mines. John H. Haertter. Shows that wood pipe withstands acid water better than iron, and that the cost of furnishing and laying is about 50 per cent. less. 4500 w. Eng & Min Jour—July 6, 1907. No. 85450.

**Rescue Apparatus.**

Tests of Breathing Apparatus (Bericht über Versuche mit Atmungsapparaten). Herr Grahn. Gives the results of elaborate tests of various types of breathing apparatus to determine their power of supplying pure air over various periods of time and also to determine their effects on the user. 4200 w. Glückauf—June 22, 1907. No. 85631 D.

A Unique English Rescue Apparatus for Mines. Frank C. Perkins. Illustrated description of the "Pneumatogen," designed by Dr. Fried Böck and Prof. Max Bamburger. 1800 w. Min Rept—July 4, 1907. No. 85433.

First Report of the Royal Commission on Mines. Deals principally with rescue work in collieries. Gives experiments made with various types of apparatus by Dr. Boycott. 4000 w. Col Guard—June 21, 1907. No. 85396 A.

**Thick Seams.**

Rib Drawing in the Connellsville Coke Region. G. S. Baton. Describes methods adapted to mining thick seams under moderately heavy cover. 1000 w. Mines & Min—July, 1907. No. 85423 C.

**Thin Seams.**

The Panel Retreating System. S. J. Jennings. Describes an adaptation of the panel system for mining thin seams of anthracite, giving comparative costs of three systems of working. 2500 w. Mines & Min—July, 1907. No. 85418 C.

**Ventilation.**

Practical Experiments in Coal-Mine Ventilation. W. D. Owens. A summary

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of a series of tests made for the purpose of investigating disputed points concerning the action of fans. 2000 w. Eng & Min Jour—July 13, 1907. No. 85550.

## COPPER.

**Assaying.**

The Iodometric Determination of Copper. F. A. Gooch and F. H. Heath. A discussion of this method with a study of the conditions in the process and their influence. 2500 w. Am Jour of Sci—July, 1907. No. 85705 D.

**Australia.**

Australian Copper Deposits. John Plummer. A review of this industry in Australia, showing that while not the largest known producing country, it is becoming an important factor in the world's supply. 1000 w. Min Wld—June 29, 1907. No. 85366.

**Colorado River.**

Copper Mining on the Colorado River. J. George Hately. Information in regard to this district and its development. Map. 700 w. Min Wld—June 29, 1907. No. 85365.

**Electrolytic Process.**

The Electrolytic Reduction of Low-Grade Ores. Day Allen Willey. Illustrated description of methods used by the Tacoma Smelting and Refining Company for copper and lead ores. 1200 w. Elec Rev, N Y—July 13, 1907. No. 85535.

The Electrolytic Process of Copper Recovery. Walter Stoeger. Describes a process invented by Dr. St. von Laszczynski. 2000 w. Min Jour—July 6, 1907. Serial. 1st part. No. 85588 A.

**Low Grade.**

Three Large Low-Grade Copper Camps. Etienne A. Ritter. Concerning the camps of the Boundary District, B. C.; of Bingham, Utah; and of Ely, Nevada. Ills. 1800 w. Min Wld—July 20, 1907. No. 85831.

**Mine Waters.**

Precipitating Copper from Butte Mine-Water. A. F. Bushnell. An account of the recovery of copper by precipitation, with an illustrated description of the methods used by the East Butte Copper Co. 1000 w. Eng & Min Jour—June 29, 1907. No. 85330.

**Ore Deposits.**

Some New Points in the Geology of Copper Ores. James F. Kemp. Considers briefly the subjects of secondary enrichment, persistance of ore in depth, and other matters of interest. 2200 w. Can Min Jour—July 15, 1907. No. 85787.

Origin of Copper Impregnations in Sedimentary Rocks. Arthur Lakes. A suggestion to account for such sedimentary impregnations. 500 w. Min Rept—June 27, 1907. No. 85361.

**Refinery.**

Refinery of Rio Tinto Co., Port Talbot, Wales. Edward Walker. Illustrates and describes new works for the production of copper ingots, wire-bars, and cakes from precipitate and Bessemer bars obtained in Spain. 1000 w. Eng & Min Jour—July 20, 1907. No. 85841.

**Schuyler.**

The Schuyler Mine. J. H. Granbery. Gives the early history of the first mine operated by Europeans in the United States. A copper mine in New Jersey. 4500 w. Jour Fr Inst—July, 1907. Serial. 1st part. No. 85701 D.

**Smelter.**

The Humboldt Smelter, Arizona. O. H. Fairchild. Illustration, with description, of a plant for the treatment of both copper and lead ores. 1700 w. Min Rept—July 18, 1907. No. 85820.

**Smelting.**

Copper-Smelting Practice in the Boundary District, British Columbia. Frederic Keffer. An illustrated article describing the ores, their composition, treatment, and the Greenwood plant, which embodies the latest practice of this district. 2000 w. Engineering Magazine—Aug., 1907. No. 85914 B.

## GOLD AND SILVER.

**Arizona.**

Lead-Silver Deposits of Mowry, Ariz. R. B. Brinsmade. Describes the caving system of mining 80 per cent. of the ore without timbering, the complicated milling, and methods of smelting. Ills. 2500 w. Mines & Min—July, 1907. No. 85417 C.

**Black Sands.**

The Auriferous Black Sands of California. Dr. David T. Day. Gives the scope and results of the investigation by the United States Geological Survey. 2700 w. Mines & Min—July, 1907. No. 85424 C.

**British Columbia.**

Peace River Valley District of British Columbia. William Fleet Robertson. A report giving an illustrated description of the country, noting the physical and geological formations, the mineral possibilities of copper, silver and gold ores, etc. 5000 w. B C Min Rec—June, 1907. No. 85964 B.

**California.**

Geology of the Bodie District, California. R. P. McLaughlin. Describes a district which at one time ranked among the foremost gold districts of California. 1800 w. Min & Sci Pr—June 22, 1907. No. 85364.

The Geology of the Coffee Creek Mining District. Norman S. Stines. Describes this district in Trinity Co., California, and its gold-bearing minerals. 1500 w. Min & Sci Pr—July 6, 1907. No. 85523.

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Some Ore Deposits in the Inyo Range, California. John A. Reid. An account of the conditions under which lead and silver are found in this range. Diagrams. 2200 w. Min & Sci Pr—July 20, 1907. No. 85960.

**Cyaniding.**

Cyanide Practice at the Homestake Mills. F. L. Bosqui. Briefly describes these plants at Lead, South Dakota, and interesting features of the practice. 1800 w. Min & Sci Pr—July 6, 1907. No. 85522.

**Dredging.**

The Modern Gold Ship. George Ethelbert Walsh. An illustrated description of the work of the gold dredge in California. 1500 w. Sci Am Sup—July 6, 1907. No. 85412.

Gold-Dredging Practice at Ruby, Montana. J. P. Hutchins. An illustrated account of how the Conrey Placer Mining Company has met a series of difficult conditions in handling clayey gravel and boulders. 3000 w. Eng & Min Jour—June 29, 1907. Serial. 1st part. No. 85328.

**Great Mines.**

The Great Silver and Lead Mines. T. A. Rickard. Information of interest in regard to the greatest producers. Ills. 700 w. Min & Sci Pr—June 22, 1907. No. 85363.

**Mexico.**

Concluding Notes on Guanajuato. T. A. Rickard. Remarks on native labor, and description of the flood of July, 1905. Ill. 1500 w. Min & Sci Pr—July 20, 1907. No. 85961.

The Mines of La Luz, Guanajuato, Mexico. John A. Church. The present article describes the geology of this district, now being reopened. Map. 4000 w. Eng & Min Jour—July 20, 1907. Serial. 1st part. No. 85840.

The Historic Mines of Proano. Paul W. Meyers. An interesting illustrated account of these old silver mines. 3000 w. Min Wld—July 6, 1907. No. 85475.

Proano, a Famous Mine of Fresnillo, Mexico. John A. Church. Gives the early history, geology and description of a remarkable development of veins which yielded $800,000 annually for 67 years. 1800 w. Eng & Min Jour—July 13, 1907. No. 85547.

**Montana.**

Granite-Bimetallic and Cable Mines of Montana. W. H. Emmons. Describes the geology and ore deposits of the famous Granite Mountain silver mine of the Philipsburg quadrangle in the present number. 3500 w. Ores & Met—July 5, 1907. Serial. 1st part. No. 85432.

**Nevada.**

The Chipmunk Gold Belt, Nevada. Describes this district. The ores are gold with only a trace of silver, and no base metals have as yet been found in this belt. 800 w. Min Rept—July 4, 1907. No. 85434.

**Nova Scotia.**

The Gold Mining Industry of Nova Scotia. E. Percy Brown. Reviews the history of this industry in Nova Scotia, showing the clauses that have interfered with the development. 4500 w. Can Min Jour—July 15, 1907. No. 85786.

**Peru.**

The Silver & Copper-Bearing Veins of Huancavelica, Cerro de Pasco, Peru. Carlos E. Velarde. Describes the geology of this region, the deposits, etc. 2000 w. Min Jour—June 22, 1907. No. 85395 A.

**Placers.**

Examining a Placer Property. George W. Maynard. Outlines methods and gives an account of an investigation of property in Arizona. 1800 w. Min Wld—July 6, 1907. No. 85474.

Ways of Cleaning Up in Hydraulic Placer Mining. Dennis H. Stovall. Shows how gold and platinum may be lost through carelessness, and gives suggestions as to methods of reducing these losses. 1000 w. Ores & Met—July 20, 1907. No. 85899.

**Slimes.**

The Filtration of Slime by the Butters Method. E. M. Hamilton. A detailed description of the inception, construction, and method of working of this patent filter. Ills. 3500 w. Min & Sci Pr—June 22, 1907. Serial. 1st part. No. 85362.

**Stamp Mill.**

A Gold Stamp Mill for Laboratory Testing. Frederick H. Sexton. Describes a stamp mill designed to provide a wide range of adjustment, and suitable for testing ores for the best milling conditions. Ills. 1500 w. Min Wld—July 6, 1907. No. 85479.

**Tibet.**

The Tibetan Goldfields. Dr. Malcolm Maclaren. Map and information in regard to the gold-bearing area of southwestern Tibet. 4000 w. Min Jour—June 22, 1907. No. 85393 A.

**Witwatersrand.**

Working Costs of the Mines of the Witwatersrand. Ross E. Browne. Information collected in the course of inspection of mines during 1904 and 1905. 15000 w. Tables and diagrams. Jour S African Assn of Engrs—May, 1907. No. 85378 F.

## IRON AND STEEL.

**Blast Furnaces.**

The Modern American Blast Furnace. Bradley Stoughton. An illustrated article explaining how the modern blast furnace is constructed, how it is charged, and how

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the blast is supplied and heated. 1800 w. Eng & Min Jour—July 27, 1907. No. 85952.

An Example of Blast Furnace Reconstruction. Illustrated description of the modernized plant of the Richard Heckscher & Sons Company, Swedeland, Pennsylvania. 1500 w. Ir Age—July 25, 1907. No. 85877.

Iron Manufacture in Australia. Illustrated description of the Sandford Ltd. blast furnace, at Lithgow, N. S. W., and its operation. 2500 w. Aust Min Stand—May 29, 1907. No. 85491 B.

**Cuba.**

Barite Associated with Iron Ore in Pinar del Rio Province, Cuba. Charles Catlett. Describes rather unusual deposits found near the little village of Francisco. 500 w. Bul Am Inst of Min Engrs—July, 1907. No. 85927.

**Dry-Air Blast.**

Notes on the Gayley Dry-Air Blast-Process. Discussion of the paper by C. A. Meissner. 4500 w. Bul Am Inst of Min Engrs—July, 1907. No. 85922.

**Electric Smelting.**

The Electrical Smelting of Iron Ore. R. L. Phelps. An illustrated description of the plant installed on the Pitt River, California. 1500 w. Min & Sci Pr—July 20, 1907. No. 85963.

See also Electrical Engineering, Electro-Chemistry.

**Furnace Charges.**

Calculation of Furnace Charges. Regis Chauvenet. Suggestions, showing how a certain class of problems of this nature can be solved by the simple equations. 1500 w. Min Rept—July 18, 1907. Serial. 1st part. No. 85819.

**Lake Superior.**

Coleraine District, Mesabi Range. Illustrates and describes a washing plant for low-grade iron ore, and the development of the ore beds. 1800 w. Min Wld—July 6, 1907. No. 85476.

Iron Mining Practice on the Marquette Range. Reginald Meeks. An illustrated account of methods used. The caving system predominates, but milling and the inverted cone methods are also used where conditions require. 1500 w. Eng & Min Jour—June 15, 1907. No. 85046.

The Caving System on the Menominee Range. Reginald Meeks. Describes the low-grade iron ore that must be mined economically, and the block-caving, sub-level, and back-stoping methods used. Ills. 2500 w. Eng & Min Jour—July 20, 1907. No. 85838.

**New South Wales.**

Iron and Steel Industry of New South Wales. Brief account of the industry and iron ore resources of Australia, with illustrated description of the Eskbank Works. 1200 w. Ir & Coal Trds Rev—July 5, 1907. No. 85599 A.

**Piping.**

Extract of Report on Methods Used to Avoid Piping in Steel Ingots, as Applied in the Hungarian Government Steel Foundries at Diosgyor. Albert Obholzer. An illustrated account of the Anti-Piping Thermit method and results obtained. 1600 w. Jour Fr Inst—July, 1907. No. 85700 D.

The Influence of the Conditions of Casting on Piping and Segregation, as Shown by Means of Wax Ingots. H. M. Howe, and Bradley Stoughton. Experimental investigations on wax ingots concerning the influence of certain conditions of casting upon the size and condition of the pipe, and the position of the segregation, in steel ingots. Ills. 4800 w. Bul Am Inst of Min Engrs—July, 1907. No. 85921 C.

Piping and Segregation in Steel Ingots. A discussion of the paper of Prof. Howe, presented at the London meeting, July, 1906. 3000 w. Bul Am Inst of Min Engrs—July, 1907. No. 85925.

**Rails.**

See Railway Engineering, Permanent Way and Equipment.

**Rolling Mills.**

Notes on Rolling Mill Work. B. H. Reddy. Describes rolls for the production of flats, illustrating a 3-high set of rolls designed by the writer for rolling skelp. 1500 w. Ir Trd Rev—June 27, 1907. No. 85339.

The Riverside Metal Company's New Rolling Mill Plant. Illustrates and describes a new hot and cold rolling mill plant recently installed at Riverside, N. J. 2000 w. Ir Age—July 25, 1907. No. 85879.

Electrically Driven Reversing Rolls at the Hildegardehütte Steel Works (Commande Electrique d'un Laminoir Réversible). G. de Taube. Illustrated description of these works in which the Ilgner system of driving is used. 3500 w. Génie Civil—June 8, 1907. No. 85614 D.

**Spain.**

A Study of the Iron Ore Deposits of Almeria. Pablo Fabrega. The present article considers mainly the geology of the district. Map. 2000 w. Min Jour—July 6, 1907. Serial. 1st part. No. 85586 A.

**Steel Making.**

Structural Steel Making. Prof. Charles M. Spofford. Illustrates and describes the essential processes in rail and structural steel making, giving an outline of the history of the iron industry in the United States. Short discussion. 7000 w. No. 65. Pro Brooklyn Engrs' Club—1906—No. 85971 N.

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## MINING.

**Accounts.**

A Card System of Mine Accounts. R. S. Handy. Detailed description of method used by the writer. 900 w. Min & Sci Pr—July 13, 1907. No. 85834.

**Boreholes.**

The Determination by Measurement of the Depth and Direction of Deep Bore Holes (Die Feststellung des Fallens und Streichens von Tiefbohrlöchern durch Messung). Herr Erlinghagen. Discusses the various cases in mining work in which such knowledge is necessary and describes the more important instruments and methods for bore-hole surveying. Ills. Serial. 2 parts. 14000 w. Glückauf—June 8, 1907. No. 85630 each D.

Recent Stratameters and Bore Hole Surveying Instruments (Neuere Stratameter und Bohrlochsniegungsmesser). Dr. Freise. Illustrated description of several instruments recently perfected in Germany. Serial. 2 parts. 3500 w. Oesterr Zeitschr f Berg u Hüttenwesen—June 15 and 22, 1907. No. 85637 each D.

**Bosnia.**

The Mining and Electrical Industry of Dolni Tuzla, Bosnio (Die Montanindustrie und das Elektrizitätswerk von Dolni Tuzla in Bosnien). Franz Poech. Describes the geology of the district, the salt and coal deposits and methods of mining and a generating station which supplies power for the mines and for the town lighting system. Ills. 4000 w. Serial. 2 parts. Zeitschr d Oesterr Ing u Arch Ver—June 21 and 28, 1907. No. 85645 each D.

**British Columbia.**

Reconnaissance Up West Fork of Kettle River. Horace Evans. The present article describes the country. 1500 w. Min Wld—July 13, 1907. Serial. 1st part. No. 85553.

**Caving System.**

The Dome of Equilibrium and the Caving System of Mining. Claude T. Rice. Considers methods of support used in underground mining, the caving system, and gives the writer's ideas concerning the dome of equilibrium. 1500 w. Min & Sci Pr—July 20, 1907. No. 85962.

**Claim Location.**

Re-locating Mineral Lands. Rossiter W. Raymond. A discussion of court decisions bearing on the rights of original locators and re-locators of mineral claims on public lands. 2000 w. Eng & Min Jour—July 20, 1907. No. 85839.

**Clausthal.**

New Plants in the Clausthal District (Die Neuanlagen der Königlichen Berginspektion zu Clausthal). Herr Schennen. An illustrated description of recent extensions in mining and ore-dressing plants and of mining and milling methods in this important galena-zincblende district in Germany. 7000 w. Glückauf—June 1, 1907. No. 85629 D.

Recent Improvements at the Clausthal Mines. Bergrat Schennen. Trans. from *Glückauf*. The improvements relate to mining, ore dressing, and power generating. Ills. 2000 w. Min Jour—June 22, 1907. Serial. 1st part. No. 85394 A.

**Concentration.**

The Wilfley Table. Robert H. Richards. Presents a series of tests made with the Wilfley table, to study concentration of galena in presence of quartz. 6000 w. Bul Am Inst of Min Engrs—July, 1907. No. 85928 C.

**Electric Hoist.**

The Electric Hoist and Its Applications. An illustrated article calling attention to the most recent development of the electric hoist and its applications. 2500 w. Ir Trd Rev—July 18, 1907. No. 85727.

**Electric Power.**

Electric Power at the Calumet and Hecla. Carl L. C. Fichtel. An account of the adoption of high-tension alternating current to supplant steam throughout the mine and mill. 1500 w. Eng & Min Jour—July 27, 1907. No. 85953.

Under What Circumstances Is Contact with an Electrical Circuit Dangerous (Unter Welchen Umständen ist die Berührung einer Elektrischen Anlage Gefährlich?) Hermann Zipp. Discusses the various sources of danger in electrical plants, particularly with reference to the use of electricity in mines. 4000 w. Serial. 2 parts—June 10 and 25, 1907. No. 85648 each D.

**Field Geology.**

Suggestions for Field Observations of Ore Deposits. S. F. Emmons. Suggestions bearing on mechanical phenomena, chemical and mineralogical phenomena, economic and commercial conditions. 3500 w. Min & Sci Pr—July 6, 1907. No. 85521.

**Lime-Roasting.**

Laboratory Experiments in Lime-Roasting a Galena-Concentrate. Discussion of the paper of H. O. Hofman, R. P. Reynolds, and A. E. Wells. 2000 w. Bul Am Inst of Min Engrs—July, 1907. No. 85924.

**Locomotive Explosion.**

Explosion of Air Locomotive. An illustrated account of the explosion of a compressed air mine locomotive while being charged, with some suggestions as to the probable cause. 2500 w. Mines & Min—July, 1907. No. 85422 C.

**Magnetic Separation.**

Improved Magnetic Separating Machinery. R. T. Clegg. Illustrates and describes a new form of roaster and magnetic separator, designed by E. Hedburg

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for the treatment of complex ores containing lead, zinc, copper and iron in combination. 1000 w. Min Wld—July 20, 1907. No. 85832.

**Milling.**

Milling "Sheet Ground" Ore in Joplin District. Doss Brittain. Illustrates and describes the milling system in general, and some of the large mills. 3000 w. Eng & Min Jour—July 13, 1907. No. 85549.

**Mine Lamp.**

A Portable Acetylene Mine-Lamp. Edwin O. Dane. Describes this type of lamp as used in Mexican mines. Illus. 500 w. Min & Sci Pr—July 6, 1907. No. 85524.

**Prospecting.**

Interesting Cases of Misleading Prospecting. George H. Ashley. Deals with cases in eastern coal fields. 1400 w. Min Wld—July 6, 1907. No. 85478.

**Raising.**

Raising and Enlarging a Shaft (Schachthochbrechen mit Erweiterung von unten nach oben). Herr Herbst. Illustrated description of shaft raising methods at a mine in Germany, with costs. 2000 w. Glückauf—June 22, 1907. No. 85632 D.

**Roof Supports.**

Concrete Roof Supports. A successful application of concrete to replace timber roof supports in the Shamokin, Pa., region, is illustrated and described. 1500 w. Mines & Min—July, 1907. No. 85421 C.

**Shaft Sinking.**

Sinking a Shaft Through Quicksand by the Pneumatic Process. Describes difficult shaft sinking near Biwabik, Minn., to open up a rich deposit of iron ore. 2500 w. Eng Rec—July 13, 1907. No. 85543.

**Smelter Smoke.**

The Disposal of Smelter Smoke. Herbert Lang. Suggestions that smoke be conveyed by flue to remote places where it will be harmless. 2500 w. Eng & Min Jour—June 29, 1907. No. 85329.

**South Wales.**

Mining and Metallurgy in South Wales. Edward Walker. An account of this district, its coal deposits, copper smelting, lead and nickel ores, etc. Map. 1800 w. Eng & Min Jour—July 13, 1907. No. 85548.

**Stoping.**

Stoping with the Air-Hammer Drill. G. E. Wolcott. Gives a record of experience in stoping and other mine work with the air-hammer drill at Cripple Creek. 1500 w. Eng & Min Jour—July 20, 1907. No. 85843.

**Surveying.**

Some Practical Points on Mine Surveying. Laurence C. Hodson. Suggestions for work under the conditions often met with in mines. 2000 w. Eng & Min Jour—July 20, 1907. No. 85842.

The Verschoyle Pocket Transit. W. Denham Verschoyle. An illustrated description of this instrument. 600 w. Bul Am Inst of Min Engrs—July, 1907. No. 85926.

**Tunnels.**

Western Practice in Tunnel Driving. W. P. J. Dinsmoor. Illustrates and describes the methods employed in driving the Ophelia Tunnel in the Cripple Creek District. 2000 w. Min Rept—July 11, 1907. No. 85551.

Cripple Creek Drainage Tunnel Started. An account of the inauguration ceremonies. 1500 w. Mines & Min—July, 1907. No. 85419 C.

## MISCELLANY.

**Ancient Britain.**

The Mines and Agriculture of Roman Britain. Alexander Del Mar. An account of the ancient system of mining, agriculture, and highway construction. 1500 w. Min & Sci Pr—July 6, 1907. No. 85525.

**Oil Fields.**

The New Tilbury and Romney Oil Fields of Kent County, Ontario. Eugene Coste. Information in regard to the oil and gas wells of this district, with description of the geology. 2500 w. Can Min Jour—July 15, 1907. No. 85785.

**Ore Deposits.**

The Genesis of Ores. Horace V. Winchell. Commencement address delivered before the Montana School of Mines. Outlines the prevalent modern theories of the genesis of ore deposits, and calls attention to influences and conditions which have a decided bearing upon ore formation. 4800 w. Min & Sci Pr—July 13, 1907. No. 85835.

The Vein-System of the Standard Mine, Bodie, Cal. R. Gilman Brown. Illustrates and describes a very interesting vein-system, within an area of 1,000 ft. by 4,000 ft., having eight or nine successive sets of fissures, five of which are ore-bearing. 4800 w. Bul Am Inst of Min Engrs—July, 1907. No. 85923 C.

**Rare Earths.**

The Rare Earth Industry (L'Industria delle Terre Rare). V. Fino. Describes the sources of the substances commonly called the rare earths, their industrial applications and method of treatment. 4000 w. Industria—June 9, 1907. No. 85624 D.

**Tin.**

A Tin Deposit Near Spokane. A. R. Whitman. Brief note giving information bearing on the economic importance of this deposit. 600 w. Min & Sci Pr—July 13, 1907. No. 85833.

The Bischoff Tin Mining Co. James Lewis. A report on the possibility of re-

ducing working costs without reducing the proportion of tin saved. 5000 w. Aust Min Stand—May 22 and 29, 1907. Serial. 2 parts. No. 85490 each B.

Mount Bischoff Tin Mine, Tasmania. Ralph Stokes. A report aiming to explain the circumstances leading to the recent partial collapse and to give a description of the natural conditions and working methods. Ills. 3300 w. Min Wld—July 13, 1907. No. 85552.

**Vanadium.**

Vanadium in Peru. Jose J. Bravo. A preliminary report on the vandiferous region of Minasragra. 1200 w. Min Wld—July 6, 1907. No. 85477.

**Zinc.**

The Zinc Belt of Claiborne and Union Counties, Tennessee. W. C. Clarke. Describes formations of varying richness which present a promising outlook. 1500 w. Mines & Min—July, 1907. No. 85425 C.

# RAILWAY ENGINEERING

## CONDUCTING TRANSPORTATION.

**Collision.**

The Elliot Junction Collision. Information from the report on the disastrous rear-end collision in Scotland on Dec. 29, 1906. 2000 w. R R Gaz—July 5, 1907. No. 85468.

**Safety Appliances.**

Railway Safety Appliances in America. A review of the annual report of the Interstate Commerce Commission. 2200 w. Engr, Lond—June 28, 1907. No. 85506 A.

## MOTIVE POWER AND EQUIPMENT.

**Cars.**

All Steel Passenger Cars. Drawings and description of the general structure of postal cars, and suburban passenger cars. 1400 w. Am Engr & R R Jour—July, 1907. No. 85409 C.

Invalid and Family Compartment Cars for the London & Northwestern. Illustrated detailed description of recently completed cars. 600 w. Ry Age—July 12, 1907. No. 85554.

**Car Heating.**

See Mechanical Engineering. Heating and Cooling.

**Locomotive Boilers.**

The Expansion Stresses in Locomotive Boilers. F. Douglas Wilkes. Points out the direct cause of leakage, giving his opinion of how the difficulty may be overcome, or to a great extent lessened. Ills. 1500 w. Boiler Maker—July, 1907. No. 85357.

Locomotive Boilers in 1834. Illustrates the type of locomotive used on the Liverpool & Manchester Ry. compared with one of the largest and most powerful modern American locomotives. 1500 w. Boiler Maker—July, 1907. No. 85354.

Effect of Scale on the Transmission of Heat Through Locomotive Boiler Tubes. Edward C. Schmidt and John M. Snodgrass. Reports four series of tests to determine the relative conductivities for heat of clean and scale-covered locomotive boiler heating surfaces. 3800 w. Bul Univ of Ill—April 1, 1907. No. 85822 N.

**Locomotives.**

Ulster & Delaware Ten-Wheeler. Illustrated description of a ten-wheel (4-6-0) simple engine. 400 w. Ry & Loc Engng—July, 1907. No. 85428 C.

A Remarkable Locomotive. Charles S. Lake. Illustration, with description of the new Pacific (4-6-2) type for the Pennsylvania lines. 900 w. Mech Engr—July 13, 1907. No. 85857 A.

Ten-Wheel Locomotive for the Chicago & North-Western. Illustrates and describes engines equipped with the Walschaert valve gear, designed for all-around freight service. 1200 w. R R Gaz—July 5, 1907. No. 85465.

Express Passenger Engine, Midland Railway. Plate, illustration and description of the latest type of the Midland Ry. simple express passenger Belpaire engine of the 4-4-0 type. 700 w. Engr, Lond—July 5, 1907. No. 85598 A.

Four-Cylinder Compound Express Locomotive; Danish State Railways. Two-page plate and further particulars of the "Atlantic" type locomotive, designed by O. Busse. 1700 w. Engng—June 28, 1907. No. 85501 A.

Passenger Locomotive for the Duchy of Oldenburg Railroads. An illustrated description of an engine of the 4-4-0 type, the 5,000th locomotive built by the Hannoversche Maschinenbau - Actien - Gesellschaft. 1000 w. R R Gaz—July 19, 1907. No. 85784.

Passenger Locomotives of the 4-4-4 Type with Bar Frames: Bavarian State Railways. Illustration, with description of some notable engines for fast service with heavy passenger trains. 700 w. Eng News—July 25, 1907. No. 85887.

Recently Constructed Italian Locomotives. Charles S. Lake. Photographs and descriptions of recent engines built by the Società Italiana. Ernesto Breda, of Milan. 2000 w. Mech Engr—July 6, 1907. No. 85579.

**Locomotive Tests.**

Locomotive Road Tests. W. H. Win-

*We supply copies of these articles. See page 1007.*

terrowd, W. L. Scantlin, W. L. Batt, F. A. Schaff. Tests made to determine the relative efficiencies of consolidation locomotives equipped with Walschaert and with the Stephenson valve-gears. Ills. 1000 w. Purdue Engng Rev—1907. No. 85935 N.

**Milan Exposition.**

Locomotives at the Milan Exposition, 1906 (Die Lokomotiven auf der Mailänder Ausstellung, 1906). Herr Schwarze. The first instalment of the serial illustrates and describes the German exhibits. 3500 w. Serial. 1st part. Glaser's Ann—June 1, 1907. No. 85666 D.

Passenger and Freight Cars at the Milan Exposition, 1906 (Personen- und Güterwagen auf der Mailänder Ausstellung 1906). Herr Messerschmidt. Gives the general characteristics of the exhibits from the various European countries. 2200 w. Glaser's Ann—June 1, 1907. No. 85664 D.

**Motor Cars.**

Motor Car or Locomotive (Motorwagen oder Lokomotive). Emil Schimanek. Discusses the results of tests made on the Hungarian State Railways to determine the relative economy of motor car and locomotive operation over short hauls. 3000 w. Glaser's Ann—June 15, 1907. No. 85668 D.

The Steam Motor Car Under Test on the Italian State Railways (Le Vetture Automotrice a Vapore in Esperimento sulle Ferrovie dello Stato). Illustrated description of the car and motor. 3000 w. Monit Tech—June 30, 1907. No. 85622 D.

Steam Railway Motor Carriage for India. Illustrated description of recently ordered self-propelled cars for the East Indian Railway Co. 500 w. Engr, Lond—June 28, 1907. No. 85505 A.

**Train Lighting.**

Storage Battery Developments in Train-Lighting Service. C. R. Gilman. Describes briefly the three principal systems of electric train lighting, with remarks on special features and the care needed. Ills. 2500 w. Ry Age—June 28, 1907. No. 85359.

See also Electrical Engineering, Lighting

**Wheels.**

A Traction Wheel with Sinusoidal Tread. Illustrates and describes a wheel invented by Bernhard Beskow, stating the advantages claimed. 800 w. Sci Am—July 13, 1907. No. 85517.

Solid Steel Wheels for Passenger Cars. George L. Fowler. Topical discussion. An interesting account of tests made, and a discussion of the causes of shelling out and of wear. 3000 w. R R Gaz—June 28, 1907. No. 85335.

## NEW PROJECTS.

**Africa.**

The Nile Red Sea Railroad. Harold J. Shepstone. Illustrated account of the building of a $7,000,000 line through a waterless land. 1000 w. Sci Am Sup—July 6, 1907. No. 85416.

**Canada.**

New Railroad Construction in Canada and the Northwest. Day Allen Willey. Illustrates and describes interesting work in connection with railroad extensions in northwestern Canada. 1000 w. Sci Am—July 6, 1907. No. 85410.

**Philippines.**

Progress in the Philippines. From a published interview with Charles A. Conant in regard to proposed extensions of the Manila Railway. 1200 w. R R Gaz—July 19, 1907. No. 85781.

**Switzerland.**

The Bodensee-Toggenburg Railroad (Die Bodensee-Toggenburgbahn). Illustrated description of this line under construction in Switzerland, giving plan and profile, an outline of the difficulties encountered, and description of some of the bridges, viaducts, stations, etc. 4500 w. Serial. 2 parts. Schweiz Bau—June 8 and 15, 1907. No. 85635 each D.

## PERMANENT WAY AND BUILDINGS.

**Detours.**

The Economics of Detour Building—A Comparison Between Wellington and Prof. Webb. Morrell W. Gaines. 1200 w. Ry Age—July 19, 1907. No. 85821.

**Rails.**

Notes on Recent Rail Design. A letter from P. H. Dudley in regard to developments and experience in rail manufacture within recent years. 1600 w. Eng News—July 25, 1907. No. 85888.

The Rail Situation. J. Kent Smith. Discusses the causes of rail fracture and the value of vanadium and the open-hearth process. 1000 w. Sci Am—July 20, 1907. No. 85740.

The Action Between Wheel and Rail. H. R. A. Mallock. Read before the Engng. Con. of the Inst. of Civ. Engrs. Considers the mutual action between the rails and wheels from the theoretical point of view. Discussion. 2500 w. Elect'n, Lond—June 21, 1907. No. 85392 A.

How May Quality of Steel Rails Be Improved? Henry M. Howe. Remarks on the frequent breakages of Bessemer steel rails, suggesting improvements in process of manufacture to prevent failures. 2800 w. Eng & Min Jour—July 6, 1907. No. 85452.

The Manufacture of Steel Rails. James C. Bayles. A discussion from the viewpoint of the rail maker, considering the influence of the dry blast in Bessemer

steel practice. 3000 w. Cassier's Mag—July, 1907. No. 85709 B.

Mechanical Experiences with Limber and Stiff Rail Sections. P. H. Dudley. Read before the Am. Soc. for Test. Materials. An illustrated article giving valuable information in regard to rails, the physical properties of the metal, etc. 3000 w. Ir Trd Rev—July 4, 1907. No. 85437.

**Salt Lake City.**

New Station, Yard and Terminal Facilities of the Harriman Lines at Salt Lake City. Description with plans and elevations from the architect's drawings. 2000 w. R R Gaz—July 12, 1907. No. 85514.

**Signaling.**

Dry Battery for Block Signal Wires. U. J. Fry. Read before the Ry. Tel. Supts.' Assn. A report of satisfactory service with a great saving in cost. 900 w. R R Gaz—July 5, 1907. No. 85470.

New Top-Mast Motor Signal. Illustrated description of a new two-position electric motor signal, known as M-113, being brought out by the General Electric Co. 1000 w. R R Gaz—July 19, 1907. No. 85780.

The Application of Electricity to the Working of Railway Points and Signals. Luis de Moraes Gomes Ferreira. Read at Engng. Con. of the Inst. of Civ. Engrs. Discussion. 2500 w. Elec Engr, Lond—June 21, 1907. No. 85385 A.

Wireless Signaling System for Railroads. Drawings and description of a sectional rail cab and block signal system embodying the invention of Frank W. Prentice. 1500 w. Sci Am Sup—June 29, 1907. No. 85316.

Block Signals in the Cab of the Locomotive. Illustrated description of a mechanical system for repeating block signals in the cab, which is controlled directly by the regular automatic block signals. 1400 w. Sci Am—July 27, 1907. No. 85892.

**Stations.**

Proposed New Union Passenger Station at Buffalo. Map, plans, illustrations, and description of a proposed union station. 1500 w. R R Gaz—July 5, 1907. No. 85469.

Passenger Station of the International and Great Northern at San Antonio, Tex. Illustration and brief description of an attractive station to cost about $75,000. 400 w. Ry Age—July 26, 1907. No. 85969.

Lausanne Station (La Gare de Lausanne). C. Jambé. A sketch of the development of Lausanne as a railway center and the improvements and extensions made in the yards and station, with a description of further extensions now under way, made necessary by increasing traffic. Ills. Serial. 2 parts. 5200 w. Bull Tech d l Suisse Rom—June 10 and 25, 1907. No. 85610 each D.

**Tracks.**

Construction of Second Track Accompanied by Reduction of Gradient. H. H. Knowlton. Deals with railroads undergoing these changes, and matters relating to their economical construction. 3000 w. Purdue Engng Rev—1907. No. 85934 N.

The Fortieth St. Track Elevation of the Chicago Junction Ry. Illustrated detailed description of track elevation under unusually difficult conditions. 4000 w. Eng Rec—July 13, 1907. No. 85537.

**Turntables.**

Turntable Deflection. A. A. Kellogg. Gives a graphical method used by the writer for determining deflection. 800 w. Purdue Engng Rev—1907. No. 85933 N.

## TRAFFIC.

**Co-operation.**

Relations Between Shippers and Railways. Abstract of a recent address by P. W. Coyle, to the industrial traffic managers of the Business Men's League of St. Louis, urging co-operation for the removal of present difficulties. 1400 w. Ry Age—July 26, 1907. No. 85970.

**Demurrage.**

The Harriman Lines and Reciprocal Demurrage. Gives a copy of the letter addressed to officers and agents of the Union Pacific, signed by A. L. Mohler, Vice-President and General Manager of the Lines East of Green River. 3000 w. R R Gaz—July 19, 1907. No. 85782.

**Rates.**

German Export Railway Rates. Information from a recently issued report. 2200 w. Engng—July 12, 1907. No. 85873 A.

**Train Loads.**

Heavy Freight Trains. Editorial on the growth of car capacity, train loads, etc. 1800 w. R R Gaz—July 12, 1907. No. 85512.

## MISCELLANY.

**Government Control.**

See Industrial Economy.

**Holland.**

Reorganization and State Exploitation of Railways (Reorganisatie en Staatsexploitatie van Spoorwegen). T. Sanders. A discussion of government ownership in Holland. Ills. 12000 w. De Ingenieur—June 8, 1907. No. 85690 D.

**Legislation.**

The New Haven-Boston & Maine Anti-Merger Law. Editorial discussion of the anti-merger bill and the present situation. 1200 w. R R Gaz—July 12, 1907. No. 85511.

*We supply copies of these articles. See page 1007.*

# STREET AND ELECTRIC RAILWAYS

**Canada.**

Electric Railway Development in Eastern Canada. Patrick Dubee. Read before the Canadian St. Ry. Assn. Remarks on the operation of electric railways in a country where climatic conditions are severe in the winter months. 900 w. St Ry Jour—July 6, 1907. No. 85446.

**Cars.**

Pacific Electric Passenger Cars. Illustrates and describes various types of rolling stock operated by the Pacific Electric Railway Co. of Los Angeles, Cal. 1000 w. Elec Ry Rev—July 20, 1907. No. 85818.

**Conductors.**

Experimental Determinations of Physical Properties for the Calculation of Alternating-Current Railway Conductors (Experimentelle Bestimmungen der für die Berechnung von Wechselstrombahn-Leiteranlagen Maszgebenden Physikalischen Gröszen). Leo Lichtenstein. Enumerates the tests that should be made and describes the experiments and results obtained on the Marienfelde-Zossen Railway. Ills. 12500 w. Serial. 2 parts. Elektrotech Zeitschr—June 20 and 27, 1907. No. 85687 each D.

**Costs.**

The Operating Costs and Revenue of Urban Railways. Gerard B. Werner. Gives an analysis of the last annual report of the Interborough Rapid Transit Company of New York City. 2000 w. Engineering Magazine—Aug., 1907. No. 85915 B.

**Efficiency.**

Relation Between Maintenance of Track and Equipment of Interurban Lines. W. R. W. Griffin. Read before the N. Y. State St. Ry. Assn. An analysis showing that good tracks greatly extend the time of renewal of cars and electrical equipment. 500 w. St Ry Jour—June 29, 1907. No. 85370.

The Effect of the Transmission Line Upon the Reliability and Efficiency of Electric Interurban Railway Service. E. R. Cunningham. Discusses the methods of connecting the transformers and starting the rotary converters in the sub-stations so that a loss of one, or even two, of the transmission wires will not interrupt the service. Also other details affecting the reliability and efficiency. 2500 w. St Ry Jour—July 6, 1907. No. 85444.

Notes on Tramway Wear and Maintenance. C. F. Wike. Read before the Incor. Assn. of Munic. & Co. Engrs. Gives particulars as to the Sheffield tramways. Ills. 2000 w. Tram & Ry Wld—July 4, 1907. No. 85853 B.

**Electrification.**

A. C. Electrification on the Illinois Traction System. John R. Hewitt. Illustrates and describes the extensive a. c. single-phase lines recently completed and those under construction, with the apparatus employed in their operation. 5500 w. St Ry Jour—July 6, 1907. No. 85443.

The Introduction of Electric Traction on the Berlin City, Belt Line, and Suburban Railways (Die Einführung des Elektrischen Zugbetriebes auf den Berliner Stadt-, Ring- und Vorortbahnen). W. Reichel. An exhaustive consideration of the problem of applying electric traction to lines at present operated by steam. Ills. 6000 w. Serial. 1st part. Zeitschr d Ver Deutscher Ing—June 22, 1907. No. 85678 D.

**Equipment.**

Freight and Miscellaneous Equipment of the Pacific Electric Company. An illustrated description of the freight equipment and miscellaneous rolling stock. 900 w. Elec Ry Rev—July 27, 1907. No. 85966.

Standardization of Electric Railway Equipment. C. B. King. Read before the Canadian St. Ry. Assn. Discusses the wearing parts that could be standardized and so facilitate repairs and lessen expenses. 2500 w. St Ry Jour—July 6, 1907. No. 85445.

**Extension.**

Ocean City Extension of the Atlantic City & Shore Railroad. Illustrated detailed description of this new line, recently opened. 1000 w. Elec Ry Rev—July 6, 1907. No. 85440.

**Hague.**

The Hague Tramway Company (Het Bedrijf der Haagsche Tramweg-Maatschappij). E. F. Suringar. An illustrated description of the generating station, tracks, rolling stock, etc., of the Hague municipal tramway. 6500 w. De Ingenieure—June 22, 1907. No. 85691 D.

**Interurban.**

The Plans of the Boston and Eastern Electric Railroad. Gives an abstract of plans submitted for the building of a high-speed interurban railroad. 5000 w. St Ry Jour—July 13, 1907. No. 85531.

**Italy.**

Tests of Electric Traction on Italian Railways (Les Essais de Traction Electrique sur les Chemins de Fer Italiens). Philippe Tajani. Discusses the importance of the immense water powers of

*We supply copies of these articles. See page 1007.*

Italy, progress in the electrification of steam railroads, state regulation, etc. 8000 w. Rev Inter Econ—June, 1907. No. 85608 H.

**Motors.**

Motors for Railway Service. Explains the difference between torque and horsepower, the relation between the speed of the motor shaft and the speed of the car, etc. 1400 w. Ry & Loc Engng—July, 1907. No. 85430 C.

**Mountain.**

The Modern Mountaineer. Information in regard to the proposed Matterhorn railway, illustrating the type of car which will be used on the lower slopes. 1200 w. Ry & Loc Engng—July, 1907. No. 85426 C.

**N. Y. Central.**

The New York Central's Electric Lines. Map, illustrations and general information in regard to these lines and the service, especially between Little Falls and Syracuse. 2000 w. R R Gaz—July 19, 1907. No. 85783.

**Ontario.**

Electric Railway Development in Ontario. R. J. Clark. Read before the Canadian St. Ry. Assn. Statistics showing the general progress, with historical details of early lines. 1200 w. St Ry Jour—July 6, 1907. No. 85447.

**Power Plants.**

The Power Plant of the Norfolk & Portsmouth Traction Co. Illustrated detailed description of a thoroughly modern plant which will furnish power to operate a number of electric railways. 3000 w. Eng Rec—July 6, 1907. No. 85454.

The Steam Power Station of the Twin City Rapid Transit Company, Minneapolis. Illustrated description of a steam-driven electrical generating station having a normal rated capacity of 35000 h.p. and an overload capacity of 50000 h.p. 3500 w. St Ry Jour—July 27, 1907. No. 85949.

The Power Plant of the Norfolk & Portsmouth Traction Company. A new generating station at Norfolk, Va., with a capacity of 10,500 kw., made up of a 1,500-kw. and three 3,000-kw. turbo-generator units, and modern in all the details of its design is illustrated and described. 2500 w. St Ry Jour—July 13, 1907. No. 85530.

New Turbine Generating Station of the Illinois Traction System at Peoria, Ill. Illustrated description of the interesting features of this station. The method of handling the coal and ashes, the vertical machinery in the turbine room, etc. 1500 w. St Ry Jour—July 20, 1907. No. 85830.

**Shops.**

Shops and Shop Practice of the Los Angeles Railway. An illustrated article describing the new shops and storage buildings and outlining some of the interesting shop methods. 3000 w. Elec Ry Rev—July 6, 1907. No. 85439.

Some Notes on Electric Railway Shops and Shop Practice in Central New York. W. H. Collins. Read before the N. Y. State Ry. Assn. Pronounces the shops very inadequate, lacking suitable tools and sufficient room. 1000 w. St Ry Jour—June 29, 1907. No. 85367.

**Single Phase.**

The Single-Phase Motor and City Trolleys. Walter I. Tamlyn. Discusses briefly the requirements of city service, giving reasons why the single-phase motor is not likely to replace the direct-current type. 1000 w. Elec Rev, N Y—July 27, 1907. No. 85951.

**Third-Rail.**

New York, Auburn and Lansing Railroad. A third-rail line for general freight business and passenger traffic, now under construction, is illustrated and described. 2800 w. Elec Ry Rev—July 13, 1907. No. 85502.

**Three-Phase.**

Notes on Three-Phase Traction. Gerard B. Werner. From a paper read before the Elec. Engng. Soc. of Columbia Univ. Explains structural features of the three-phase locomotive, speed control, and other matters of interest. 1800 w. Elec Rev, N Y—July 20, 1907. No. 85836.

**Trunk Lines.**

Electric Trunk Line Operation on Lines with Heavy Grades (Elektrischer Betrieb auf Vollbahnstrecken mit Starken Steigungen). Herr Mühlmann. Discusses experiences on the mountain lines of the Würtemberg State Railways. Ills. 3300 w. Glaser's Ann—June 15, 1907. No. 85667 D.

**Tube Railways.**

The Saint-Michel Station of the Paris Metropolitan. Brief illustrated description of the method of construction in connection with building a tube under the Seine. 2000 w. Sci Am Sup—July 20, 1907. No. 85744.

Charing Cross, Euston, and Hampstead Railway. Illustrates and describes this recently completed line, and giving information concerning the undertaking of the Underground Railways Co. Also editorial. 6000 w. Tram & Ry Wld—July 4, 1907. No. 85852 B.

The Baker St.-Waterloo Tube Railway in London (Ueber die Baker Street-Waterloo Tunnel-Röhrenbahn in London). E. A. Ziffer. Illustrated description of tube, stations, cars, etc. 3500 w. Mitt d Ver f d Förd d Lokal u Straszenbahnwesens—June, 1907. No. 85694 F.

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## EXPLANATORY NOTE- THE ENGINEERING INDEX.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter X is used it indicates that copies are not readily attainable, and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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## THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bull. Am. Iron and Steel Asso. *w.* Phila., U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bulletin Univ. of Kansas. *b-m.* Lawrence.
Bull. Int. Railway Congress. *m.* Brussels.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Cement. *b-m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Deutsche Bauzeitung. *b-w.* Berlin.

Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* So. Bethlehem, Pa.
Eisenbahntechnische Zeitschrift. *b-m.* Berlin.
Electrical Age. *m.* New York.
Electrical Engineer. *w.* London.
Electrical Review. *m.* London.
Electrical Review. *w.* New York.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Review. *w.* Chicago.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electrochemical and Met. Industry. *m.* N. Y.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m* Chicago.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Far Eastern Review. *m.* Manila, P. I.
Fire and Water. *w.* New York.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. dei Lav. Pubb. e d Str. Ferr. *w.* Rome.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Ice and Refrigeration. *m.* New York.
Industrial World. *w.* Pittsburg.
Ingenieria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron and Steel Trades Journal *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A.
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Madrid Cientifico. *t-m.* Madrid.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *w.* Cleveland, U. S. A.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Métallurgie. *w.* Paris.
Minero Mexicano. *w.* City of Mexico.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Reporter. *w.* Denver, U. S. A.
Mittheilungen des Vereines für die Fôrderung des Local und Strassenbahnwesens. *m.* Vienna.
Motor Wagon. *w.* Cleveland, U. S. A.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nature. *w.* London.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochenschr. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Quarry *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revista d Obras. Pub. *w.* Madrid.
Revista Tech. Ind. *m.* Barcelona.
Revue de Mécanique. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Revue Technique. *b-m.* Paris.
Rivista Gen. d Ferrovie *w.* Florence.
Rivista Marittima. *m.* Rome.
Schiffbau. *s-m.* Berlin.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Stahl und Eisen. *s-m.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Street Railway Journal. *w.* New York.
Technograph. *yr.* Urbana, Ill.
Technology Quarterly. *qr.* Boston, U. S. A.
Tijds v h Kljk. Inst. v Ing. *qr.* Hague.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
Wood Craft. *m.* Cleveland, U. S. A.
Yacht. *w.* Paris.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagon Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a S.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.

# IMPROVED MACHINERY

## New Processes and Appliances

*The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.*

### The Scherzer Rolling Lift Bridges.

IN no field of engineering activity has there been more remarkable progress in recent years than in that of railway transportation. The giant locomotive and the eighty-thousand-pound freight car, like the Leviathan steamship, have become modern symbols of efficiency, economy, and speed. This is obviously because American railway engineers and managers have established a world-wide reputation for progressiveness, through their wide-awake policy of promptly investigating and readily adopting every new device which insures an increase in the efficiency, safety, and economy of their operations. And a striking example of this progressive policy is presented in the comparatively recent introduction, and already widespread use, of the Scherzer Rolling Lift Bridge, which we have pleasure in presenting to our readers.

The first of these bridges was completed at Chicago in 1895, for the Metropolitan Elevated Railroad Company; and it proved to be such an instant and complete success, that numerous other like bridges were at once ordered for many of the crossings in and about Chicago at points where traffic is heaviest. Thus, the device has become the key to the transportation

SCHERZER ROLLING LIFT BRIDGE ACROSS CHICAGO RIVER, CHICAGO, ILL.—BRIDGE CLOSED.

system at this great center, where railway traffic and street traffic are enormous in volume, and where both meet and interchange with an equally enormous lake and canal traffic.

A study of the two illustrations here presented will enable the reader to see at a glance just why the introduction of this bridge marks a new era in the progress of movable bridge science. It will be observed that the structure is what may be termed a "balanced" bridge—that is, the two ends of each span are so nearly balanced in weight that a minimum of power is required to operate the device, instantly and quickly; any available power, be it electricity, steam, or a gas engine, will answer the purpose; and one man can safey operate the plant from either side of the canal or stream.

The entire navigable channel is available, and is unobstructed for the passage of vessels. The span of the bridge may be made either large or small, to fulfill any requirements of navigation, without impairing the simplicity, safety or efficiency of the bridge; and when opened for the passage of vessels, the bridge itself acts as a barrier to close the roadway, and thus absolutely prevents the many serious accidents common to swing bridges when opened.

The complete success of the original four-track Scherzer bridge, built at Chicago in 1895, at once attracted the attention of railway engineers and managers elsewhere, and as a result the New York, New Haven & Hartford Railroad Company promptly ordered a six-track bridge for the entrance to their great Terminal Station in Boston, where six tracks had to be accommodated across Fort Point Channel. If a six-track swing bridge were built, all the tracks would have to be built on one movable structure, and any injury to the structure would tie up the railroad traffic at this important station. With the Scherzer bridge the six tracks could be accommodated by building three double-track bridges, side by side, to be operated either jointly or separately, as desired. Injury to one bridge would not interfere with traffic across the remaining bridges. The speed of operation, safety, economy, and efficiency, demonstrated by this first large bridge, induced the same company to decide to remove its center-pier swing bridges at Bridgeport, Westport, Cos Cob, Housatonic River and Connecticut River, in the State of Connecticut; also at the Bronx and Hutchinson Rivers, New York, and the Neponset River, Massachusetts, and replace them all with modern Scherzer bridges, each accommodating four or six tracks, formed of double-track bridges placed side by side. Whenever the traffic of the railroad increases and requires additional parallel tracks and bridges, they can be readily added without interfering with the existing traffic or bridges, as the new structures can be built alongside each other, to carry any number of parallel tracks that may be desired. This advantage is lost when a swing bridge is built. To provide additional tracks, the swing bridge must be removed, at great loss, to be replaced by a new and wider and longer structure.

The numerous advantages of the Scherzer bridge were also recognized in 1898 by the interested railroad companies in the adoption and construction of the eight-track bridge of this type, consisting of four double-track bridges, across the Sanitary and Ship Canal at Chicago, instead of a center-pier swing bridge. The companies using this very large bridge are the Pennsylvania lines, the Baltimore & Ohio Railroad, the Chicago Terminal Transfer Railroad and the C. J. Railroad.

The C., C., C. & St. L. Railroad was the first to adopt a Scherzer bridge for construction at Cleveland, Ohio, to supersede a center-pier swing bridge. The success of this bridge soon led to their decision to adopt this modern type of bridge to take the place of their double-track main line bridge, also at Cleveland. The new bridge was constructed and placed in service without requiring a temporary bridge or diverting or delaying the railroad traffic. This could not be accomplished with a swing bridge or any other type of movable bridge. And it was this particular advantage which first attracted the attention of the engineers and management of the Southeastern & Chatham Railroad, England, leading to the adoption of a Scherzer bridge, which has been constructed and placed in successful operation on their main lines across the Swale River, England.

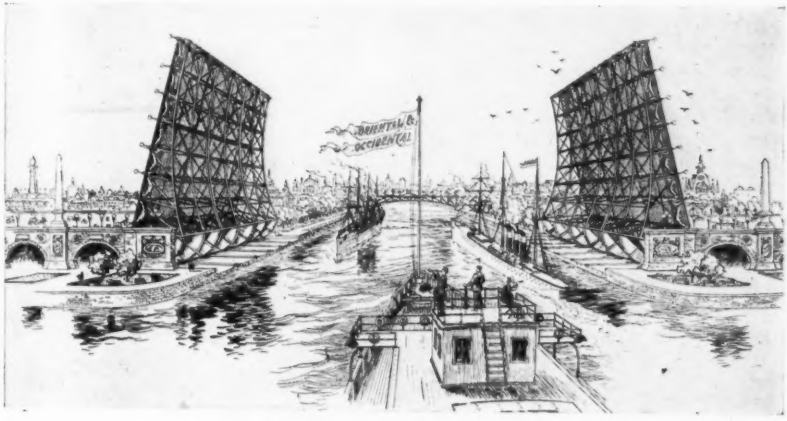
As a result of these demonstrations,

more than sixty additional railroad, electric railway, and highway Scherzer bridges have been constructed, or are in process of construction, in the United States—the principal railroad companies who have ordered them, beyond those mentioned, being the Big Four, the Pennsylvania, the Baltimore & Ohio, the Central of New Jersey, the Norfolk & Western, the New York, Chicago & St. Louis, the Newburgh & South Shore, and many others.

Following the example of American railway engineers, many of the leading foreign railroad companies are also progressively modernizing their lines and adopting the new bridge. The Scherzer bridge across the Suir River, Ireland, for the Fishguard Baker for the new Buccleugh Bridge, Barrow-in-Furness, England, and substantial progress is being made in the construction of the Walney Island Bridge, England, and the Ekaterinhofka Bridge, Russia.

For all of these structures, varying in size and for a wide variety of purposes, the Scherzer Rolling Lift Bridge Company. Monadnock Block, Chicago, furnish the designs, plans and specifications, together with the services of their consulting engineers, for co-operation with the engineers of the various railroad companies, Governments, and municipal corporations.

The above record includes the largest and most important railroad, electric railroad, and highway movable bridges con-




ENTRANCE TO CHICAGO'S INTERNAL HARBOR SYSTEM—BRIDGE OPEN.

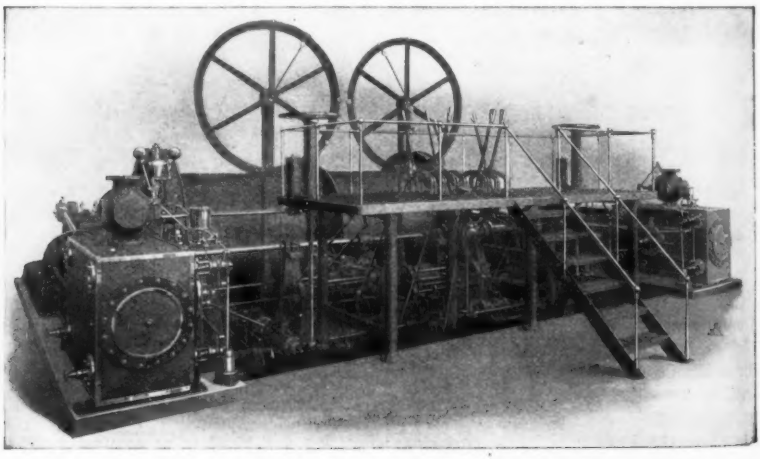
& Rosslare Railways, is nearing completion; the Buenos Ayres Great Southern Railway is building two double-track Scherzer bridges at Buenos Ayres, Argentina; the Dutch Railroad is building a Scherzer bridge across the Spaarne River, Holland, on their Main Line Fast Mail Route, and among recent foreign orders secured are: One by cable from the Government of Khartoum, Egypt, for a duplicate of the large double-track Scherzer bridge built for the Newburgh & South Shore Railroad, Cleveland; also an order from the Burma Railways for a long span Scherzer bridge to be constructed across Ngawun River, India; also an order from Sir Benjamin structed throughout the world during the past ten years. It is an unparalleled record, as all the bridges constructed have been eminently successful and have resulted in repeated orders.

The successful solving of the many large and important problems connected with the design and building of so vital a structure as a movable bridge demands the services and extended experience of the highest order of consulting engineering specialists. This is demonstrated by the numerous expensive experiments with swing bridges which have delayed and endangered traffic and in many cases, after only a few years of service, have had to be removed

and replaced by modern structures. Attempts at experimental movable bridge construction are especially expensive, one recent instance being a single-track railroad bridge at Cleveland, Ohio. The first cost of this bridge was very high, and it had only been placed in operation a short time when, owing to the complicated character of the structure, the great friction and other faults developed made it unsafe to operate the bridge, compelling the abandonment of all trains in and out of the terminal station and across the bridge for several weeks, while temporary repairs were being made to the bridge.

### Safety Appliances on Hoists.

THE Hancock Consolidated Copper Co., whose mines are located at Hancock, Mich., has recently ordered from the Sullivan Machinery Co., Chicago, a hoisting engine to be used for sinking the principal shaft and for permanent service, after the shaft is completed to its final depth of 4,000 feet. This hoist will be of the first motion, heavy duty, Corliss type, with engines 24" diameter by 48" stroke, and two loose



drums, 8 feet in diameter by 9 feet long, driven by band friction clutches, and designed for hoisting in balance. The drums will be grooved for 1¼" steel rope, and the maximum hoisting speed under full load will be 3,500 feet per minute. The clutches and band brakes will be steam operated, with automatic compressed air substitution in case the steam pressure falls below a given point, owing to accident or for other reasons.

It will be furnished with the Sullivan patented automatic throttle closing device and interlocking automatic stop. By these contrivances, the steam will be automatically shut off at a fixed distance from the top of the shaft, allowing the engineer to bring the cage to a stop at the desired point, by use of the brake. In case the engineer, for any reason, fails to set the brakes, they will be set automatically at the proper point, to prevent an overwind. This mechanism comprises an automatic throttle-closing device, and an automatic stopping device. Each is driven directly from the drum, and the movable parts work in harmony with the revolutions of the drum. The automatic throttle-closing mechanism is set so that the hoist operates with a wide open throttle until the cage has reached a predetermined point some distance below the surface, at which point the throttle is automatically closed and the cage comes to the landing by the momentum of the moving parts. On account of variation in loads, the cage sometimes fails to reach the dump by a few feet, and a small by-pass throttle is therefore provided, which admits steam between the main throttles and the engines, so that sufficient movement can safely be secured

to bring the cage to the landing. This throttle-closing device and the reverse engines are controlled by an interlocking mechanism, making it impossible to open the main throttles until the engine has been reversed for the down trip. An overwind under steam pressure is thus impossible. Without this mechanism the engineer might close the throttles a long time before it was necessary, and feel his way toward the top by the brake, or he might close the throttles too late, making it necessary to bring the hoist to a violent stop.

The brake is applied in the usual manner, by means of a lever operating the steam brake engine, but if, for any reason whatever, the cage should go past the dump, the brake is set automatically, bringing the hoist to a standstill almost instantly. When the automatic stop goes into action, the interlocking arrangement locks the mechanism, so that the engineer cannot start the hoist until the stop is replaced by hand. The auxiliary mechanism is very valuable, inasmuch as it permits of high hoisting speed with safety both to machinery and to men. The moving parts are brought to rest by a retardation which is the greatest possible without violent jars, which are so injurious to the ropes and engines, and dangerous to men who are being raised or lowered.

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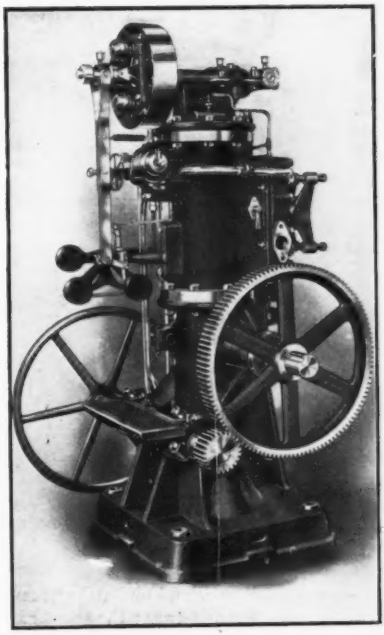
### Sturgess Water-Wheel Governor.

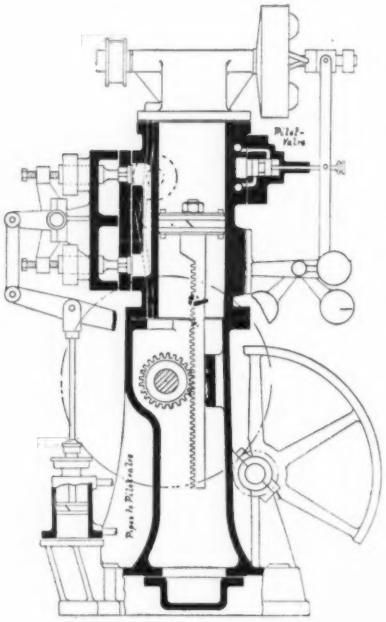
CONTINUAL improvement and advancement in hydro-electric plants requires closer regulation of the speed of water wheels. Not only is more accurate regulation demanded, but more strongly built governing apparatus and a higher degree in engineering is required in the layout and relation to the water wheel. A characteristic feature of the type "M" Sturgess governors is that they are capable of continuous service under severe duty with a minimum of care. A second and quite as important consideration is the system of poppet valves for controlling the passage of high-pressure oil to the main cylinder. Piston valves are prone to leak, whatever their form, and even if they have the maximum possible lap, whereas it is found that the cone-seated ground poppet valve remains tight indefinitely. These valves consist of four plain, cone-seated valves, which are lifted off their seats at the right times through the agency of an operating cylinder, the latter being controlled by the centrifugal governor and pilot valve. The seal or surface constituting the joint is practically perfect. If, however, the valves develop a leak through long service they are easily reground with flour emory in a few minutes. The piston



valve construction is retained in the pilot valve which controls the operating cylinder. This valve, however, is very small and hardened. The centrifugal governor employed differs from other types in being more powerful as well as more sensitive, and embodies an adjustible feature which is of the greatest importance.

The efficiency of a water wheel governor naturally lies in the centrifugal governor, for on the precision and delicacy of its motions the action of the governor as a whole depends. At times a short deflection and pronounced equilibrium is required, when at other times a large flexible movement gives the best results. The weights and

springs are carried on steel knife edges, while the sliding collars have imparted to them a circular as well as a longitudinal movement, the net result being a pure flotation of the balls in the correct position demanded by the speed, and the elimination of internal friction.



The concealed rack and pinion, by means of which the piston operates the main gate shaft, has the advantages that it is always perfectly lubricated and protected from dust or liability of damage. This rack and pinion, with the shaft, is from two to two and a half times greater than similar parts in other types of governor of the same capacity. Besides a greater strength and area of bearing surfaces obtained, an important benefit arises from the better keying which the larger shaft permits.

The compensator or anti-racing device is of a simple and unique design, which works to perfection. Being made much larger and having a greater degree of motion than similar devices on other governors it is much easier to detect at a glance whether it is working correctly, and is less liable to changes of adjustment due to variations in temperature. This governor is made by the Sturgess Engineering Department, Ludlow Valve Mfg. Co., Troy, N. Y., who will send a bulletin describing this governor on request.

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### The Multiplus Sight Feed.

THE Multiplus sight feed, which has just been put on the market and is furnished free with all new improved Rochester automatic lubricators, is, as may be seen by the accompanying illustration, a combination sight feed and three way cock. This combination has all the advantages of the sight feed, which enables the engineer to see at a glance whether or not oil is being pumped to the cylinder or point of delivery and it also has the certainty of the three way cock, by means of which the exact amount of oil being fed can be determined by simply turning the handle.

The sight feed is simple in construction, being composed of a chamber, one side of which is a heavy glass disc, against which presses a hollow plunger. In order to pass from the lubricator to the point of delivery, the oil must be forced through this plunger which has an opening in the end.

The oil in forcing its way between the glass and the end of the plunger, moves the plunger back so that only the oil is seen behind the glass, but as soon as the pressure is relieved it resumes its normal position, and the light color of the brass is seen instead of the dark oil. It will thus be seen that when the oil is being fed, that the sight feed will keep up a continual "winking." There is always a solid column of oil under pressure in the Multiplus sight feed and because of this it has the advantage over all glycerine and water sight feeds. Made by Greene, Tweed & Co., New York.

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### Fire Protection for the Shop.

A LARGE number of factories are so situated that they cannot depend upon the town or city fire department for assistance in case of fire, and even those that are located within a district covered by some fire department are liable to be totally destroyed before help can reach them. The quicker a stream of water can be turned on a blaze the greater are the chances of being able to control it before serious damage is done. This is particularly true of some plants where everything is of an inflammable nature. Insurance rates are necessarily and in many cases prohibitory on this kind of property, but there is a form of insurance whose cost for a lifetime of protection would hardly amount to one or two years of insurance premiums, as a fire pump connected to gas or gasoline engine, or by belt or gearing to water power in order that the pump can be operated independently of other machines; or, better still, connected to an electric motor, if current is available. The discharge may be piped to several fire plugs in different parts of the factory and each plug fitted with a length of hose and a nozzle. Should fire be discovered the pump could be started immediately and within a few minutes one or more streams can be directed upon the blaze. A power pump is preferable for this kind of service as they are not dependent upon the steam pressure in the boiler, which may be too low to operate a steam pump, especially out of business hours, or at night when fires more often occur; and a point of perhaps greater importance is that the power rotary pump is all made of metal, iron body and bronze working parts, so it may stand idle for years and still be in working order immediately as there are no packings or valves to dry out and become useless.

The development of the power rotary fire pump as built by the Goulds Manufacturing Co., of Seneca Falls, N. Y., has brought about many changes and improvements in the past few years and their use for this service is the result of most careful and thorough investigation. Their construction has been carefully considered and they have been subjected to rigid tests by both the manufacturers and users. Rotary power pumps have certain characteristics of the triplex power pumps. They have a triplex or three-toed cam which insures a full continuous intake and delivery with a minimum of power. The peculiar formation of these revolving cams or pistons has proven them to be of such shape as to produce a very minimum of friction and wear with the best results. The cases which receive these cams must necessarily be turned and bored, as they fit into the cases so accurately that when in operation a practically perfect vacuum is created and the pumps will pick up water quicker through a longer distance and hold it better than any other type of fire pump. As mentioned before the method of applying power is of course governed by local conditions. Where water power is available direct connection to water wheel shaft by means of frictional gearing is a very satisfactory arrangement. Other improved methods are geared connection to electric motor, direct connection by coupling to shaft of engine, and where pump and engine are located in an isolated building a belt drive is sometimes satisfactory. A system of stand pipes with valves and hose connections on each floor of the building in connection with automatic sprinklers completes the most perfect equipment for the manufacturing plant, mill or factory. The Goulds rotary pumps are built in various sizes, with capacities ranging from 125 gallons to 1,125 gallons per minute and about 100 pounds pressure on 230 feet elevation.

### Swartwout Separators.

THE accompanying illustration is a reproduction of one of three fourteen-inch Swartwout double angle type steam separators recently constructed for the Utah Copper Co., Garfield, Utah, the largest copper smelting plant in the world. These separators are built for a working pressure of 175 pounds and each weighs 3,750 pounds. These three large separators were only a part of the entire order, which included sixteen Swartwout steam separators and two thirty-six-inch Swartwout exhaust heads. The Swartwout productions (separators and exhaust heads) are constructed upon the principle of centrifugal force. In the separator the steam comes in contact with a helical worm, causing it to violently rotate, developing centrifugal force, which hurls the water to the peripheral walls of the separator, when by gravity it is deposited at the bottom of the receiver and escapes through a drip pipe. The exhaust heads operate upon the same principle by forcing or rotating the water from the steam through a helical guide. Further particulars may be had on application to the manufacturers, The Ohio Blower Company, Cleveland, Ohio.

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### Waterproofing and Masonry.

A PAPER read recently before the Western Society of Engineers, Chicago, by Edward W. DeKnight, contains an exhaustive study of waterproofing, particularly as applicable to masonry and concrete structures. We make some extracts from it:

"Steel-reinforced concrete is yet but an experiment. Nor do we know the life of the modern steel office structure. One thing is sure, that the security and life of its steel skeleton depends upon how far the columns supporting the structure are at their base rotting from electrolysis or moisture. We do not know because we do not see, but that they are decaying is true. While painting exposed steel tends to protect it, paint prevents the bonding of the steel and cement. The life of a masonry structure is indefinite. Imbedding steel in concrete or masonry, however, may or may not be dangerous. We incorporate the steel to strengthen the cement, or the cement to protect the steel—but fail to take the next step forward and protect the cement. What is the natural result? Moisture is readily absorbed by the cement, either by capillarity or through cracks, while the greater affinity of the steel alone would, and does, of itself, draw moisture through two feet of cement. The moisture in passing through the cement takes up

certain salts injurious to the steel. We know that steel, imbedded in cement and kept dry, will indefinitely retain its purity and strength. We know also that moisture, reaching the steel, creates corrosion. The immediate effect is to destroy the bond between the steel and the concrete—the heat and expanding gas from decomposition (which is progressive) pressing the cement away from the steel. And there then no longer exists, in fact, steel-reinforced-concrete, but the very opposite—a menace to life and property, which may eventually end in a collapse.

"All efforts in the waterproofing of structural work are divided into two main, totally dissimilar lines: *i. e.:* (1) treating concrete to make it, in itself, impermeable; (2) protecting concrete or masonry with something apart therefrom to waterproof them. In other words,—shall water reach the concrete, or shall it not reach the concrete?

"Under the treatment of concrete to make it, in itself, impermeable come those materials and methods for making concrete impermeable—first, by mixing certain chemicals with the concrete for the purpose of making the solid mass impermeable; and second, by applying a coating or wash to the hardened surface of the concrete, or applying thereto a cement plaster. The ingredients generally used are lime, silicate, soda, lye, soap, alum, etc. Among many objections to the first process is, that the mixing of the chemicals with the cement will not lessen the present general difficulty of having concrete properly mixed in the field. Without or with the chemicals, therefore, there will always exist zones weak in quality and density. Another objection is the uncertain effect the addition of the chemicals will have in time upon the concrete,—and particularly upon the embedded steel. One of the chief, among numerous, objections to the second method, *i. e.*, using coatings or washes, is the poor judgment in basing dependence for permanent waterproofing upon one thickness or layer of any single thing, which in this case happens to be a wash almost imperceptible in its thinness. This aside from any consideration of the fact that but one infinitesimal pore imperfectly closed by permitting the entrance of water, which would soon spread, would make valueless the balance of the washed surface.

"Under the protection of concrete with something apart therefrom to make it waterproof come those materials and methods for preventing water from coming in contact with the concrete. Practically the first efforts in this direction were to coat the surface to be waterproofed with hot coal-tar-pitch or asphalt which, however, when set and cold, cracked and separated with any settling or cracking of the masonry. Burlap was subsequently used to reinforce the pitch or asphalt without, however, preventing them from cracking, and the burlap, being of itself not waterproof did not give waterproofness. Later on there came into use for this purpose tar paper which, however, lacks pliability and tensile strength. Tar and tar paper have been extensively used for waterproofing in the past, simply because there was nothing else open to the profession. It was not until recent years that any serious effort was made to place waterproofing on a scientific basis, and to make materials specially adapted to the various conditions, materials which would not become brittle or be injuriously acted upon by water, the salts in the earth, alkali in cement, etc. The result of this specialization has been to greatly improve methods and to open to the profession products for difficult work and special conditions, considerably in advance of old school materials.

"The best material is unquestionably a strong, fibrous felt, made in itself, *i. e.*, in one sheet, absolutely impervious to water by a process of saturation and coating with materials specially adapted to withstand the injurious action of water, and particularly all underground conditions. It is then practically an impervious membrane or skin through which, of course, in one sheet, water will not pass. As many layers thereof as the conditions require can be then cemented or veneered together with a waterproof bitumen-cement, not too weak, or hard and brittle for the felt, but as strong and elastic as the felt. This forms a waterproof stratum so strong, tough, and pliable that, without injury, it can be readily pulled, bent, turned, twisted, etc. Whether in a building foundation, covering

the floor of a bridge or enveloping a tunnel it readily conforms to the final conformation of the surface waterproofed, which it insulates and protects under all conditions—settlement, jars, shocks, cracks, expansion, contraction, heat, snow, ice, water, etc.

"The speaker has termed this 'the membrane method,' and believes it the basis for the development of a perfect waterproofing. Obviously a natural waterproofing is one which skin, hide, or membrane-like, yields to the natural contraction and expansion of the structure, and protects it by preventing water from reaching it."

Mr. DeKnight submitted the following observations and rules for practical application of waterproofing:

(1) No waterproofing, especially for difficult and water-pressure work, should be undertaken when the temperature is below 25° F. Fifty per cent better work can be done when the weather is warm.

(2) Allow sufficient time, room and accommodations in which to properly apply the materials.

(3) Design the structure to receive waterproofing properly. The design will either make impossible proper waterproofing, or will invalidate the best materials after they are in place.

(4) Specify always that the waterproofing shall be done only by experienced and skilled labor. Roofing, for instance, is not waterproofing.

(5) Thoroughly protect the waterproofing during and after application.

(6) Inspect waterproofing at all times during application. See that the materials as specified are used, and also that they are themselves up to standard; that the work is done carefully and skilfully, particularly in the out-of-the-way small difficult places.

(7) Do not depend on guarantees.

(8) Do not use a set or standard specification. Each design must suit the exact conditions, and each specification must exactly suit the design.

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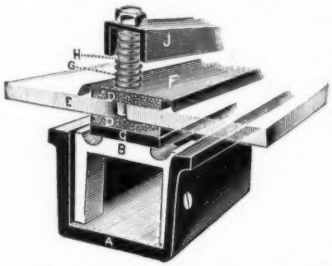
### Anti-Pluvius Skylight

THE Anti-pluvius skylight is a German invention, used on some of the largest buildings in Europe. The merits of its construction caused the G. Drouve Company to buy the U. S. patents and place the skylight on the American market about a year and a half ago. In the short time the skylight has been on the market it has been adopted by some of the largest corporations and is now in use on some of our largest buildings, including railroad shops and stations, mills and factories. To give a cursory description of the construction is all we can do here. Referring to the cut, A is the supporting steel channel bar into which are fastened at intervals of 18 or 20 inches malleable iron stirrups




B, and into these stirrups are secured solid brass studs H. On top of the stirrup rests a flat iron plate C over which is placed a strip of cowhair felt D; on top of this felt the glass E rests, with another strip of felt on top, thus giving the glass a perfect resting surface without putty or cement. Over the top strip of felt is placed a sheet metal cap F which is held in position by a brass spring G. A shoulder is cut on top of the brass stud and resting on this shoulder is the bridge J for walking on the skylight. It is thus seen that there is always a firm, elastic pressure on the glass to hold it in place and that ample allowance is made for expansion and contraction. Each glass rests independently of every other and never comes in contact with the metal or rigid surface. By means of the bridge J the skylight may be readily repaired or cleaned, broken glass reset, etc., the weight of the man being carried directly by the channel bar A without contact with or pressure on glass. There can be no dripping or condensation, the channel bar serving also as a gutter. Condensation on the glass is cross-guttered into the channel and carried off outside.

The G. Drouve Company, Bridgeport, Conn., are the sole owners and manufacturers of this skylight.

# NEWS SUPPLEMENT

The Engineering Magazine—April, 1907

### Personal.

—With sincere regret we learn of the recent death of Henry Hoefinghoff, president of the Bickford Drill & Tool Co., Cincinnati.

—Henry I. Lea, who has had considerable to do with the development of the gas producer since 1904, is about to open an office in Chicago as a consulting and contracting gas engineer.

### Industrial Notes.

—The Buffalo Forge Co. has changed the location of their Cleveland office from Room 311, Citizens' Building, to Room 618, of the same building.

—Arthur Koppel Co. have moved from their temporary office, 515 Market Street, San Francisco, to their permanent offices at 1509-11 Chronicle Building, San Francisco.

—The name of the Ross Valve Co., Troy, N. Y., has been changed to the Ross Valve Manufacturing Co. The business will be conducted as heretofore by George Ross and his three sons.

—Link-Belt Co. has acquired a new office location at 84 State Street, Boston, from which the future business of its drive chain department in New England will be looked after.

—The Rust Boiler Co., Pittsburgh, Pa., has secured the order for the boilers for the United States Steel Corporation's new plant at Gary, Ind., the order being for sixteen 400 H. P. water tube boilers.

—The Texas Fullers Earth Co., Dallas, has recently awarded the contract for the complete equipment of its plant for dryers, crushers, pulverizers, etc., to the J. R. Alsing Co., New York.

—The International Correspondence Schools, Scranton, has just issued a well-printed book containing the addresses made at the fifteenth anniversary exercises of the School, with photographs of the officers and teachers of the School and speakers.

—Crane Co., Chicago, now have their new steel foundry in full running order. In this department steel valves and fittings will be a specialty, and the facilities are such that promptness in the filling of orders for these goods is assured.

—Sales of Sturtevant generating sets are reported as follows: Richard Borden Mfg. Co., Fall River; Mallory, S. S. Co., Newport News, Va.; Faultless Mfg. Co., St. Charles, Ill.; Eastern Brass & Machine Works, Easton, Pa.

—American Blower Co., Detroit, announce that the addition to their steel plate fan shop is about completed and will be ready for occupancy shortly. The company's architects are now at work on a large addition to their power plant and to their engine construction department.

—The Chicago office of the American Steam Gauge & Valve Mfg. Co., which has been located at No. 16 North Canal Street, has been removed to new and commodious quarters at Nos. 7-9 South Jefferson Street, where they will carry a much larger stock of their staple goods and specialties than ever before.

—The S. Obermayer Co. have let contracts for large improvements for their Cincinnati plant. The improvements will consist of two-story brick building 75 x 75 ft. for manufacturing purposes; also installing 500-horse-power Greenwald Corliss engine, with new improved rope drives.

—The city of Statesville, N. C., has recently purchased three 500 k.w. Allis Chalmers power transformers for use on the Southern Power Company's circuits which supply the city at primary voltages of 40,000, 20,000 and 10,000 volts. The secondary voltages for use in Statesville will be 2300 and 575 volts.

—The Direct Separator Co., Syracuse, have

recently arranged with the Dashiell Engineering Co., Atlanta, to handle their specialties in the South, and with J. J. Dwyer, American National Bank Building, St. Paul, to sell their goods in the West, and with A. C. Stansill, Terry Building, for the State of Virginia.

—The Singer Mfg. Co., Elizabethport, N. J., who about a year ago had the Morgan Construction Co., Worcester, remodel their old style gas producers, placing automatic feeds on them, have had such good results that two producers are doing the work that formerly required three. A new 8 x 20 reheating furnace has just been installed and only one additional automatic producer was required.

—Among the rapidly increasing sales of rotary type high pressure blowers reported by the B. F. Sturtevant Co., Boston, are equipments for Union Mfg. Co., New Britain; John Russell Cutlery Co., Turners Falls, Mass.; Greer Filter Co., Hamilton, O.; Hackensack Water Co., New Milford, N. J.; Riverside Boiler Works, Boston; Andrew McLean Co., Passaic; Lumley-Dodson Co., Norfolk, Va.; St. Lawrence Water Co., Massena Springs, N. Y.; and Steamship "Iroquois."

—The advantages of a generating set in which both engine and generator are designed one for the other and manufactured by the same company, are evidenced in recent orders received by the B. B. Sturtevant Co., Boston, as follows: Three sets for the American Dredging Co., Philadelphia; two sets for Newport News S. & D. D. Co., Newport News, Va.; two sets for the Hudson Companies, New York; Pittsfield Street Ry. Co., Pittsfield, Mass.; Louis M. MacDermott, Oakland, Cal.; and Industrial Works, Bay City, Mich.

## NEW CATALOGUES AND TRADE PUBLICATIONS

*These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.*

**Automobiles.**

ASSOCIATION OF LICENSED AUTOMOBILE MANUFACTURERS, New York.—A handbook of gasolene automobiles for the information of the public who are interested in their manufacture and use. A most valuable book for one contemplating the purchase of an automobile for pleasure, or commercial purposes, as it illustrates the different cars, trucks, etc., of no less than thirty-nine automobile builders, with dimensions, specifications and prices of all machines. 5¼ by 8 in.; pp. 160.

**Ball Bearings.**

T. H. SYMINGTON Co., Baltimore.—Catalogue containing an illustrated description of center and side bearings for steam and electric cars and locomotive tenders. 9 by 7 in.; pp. 24.

**Boilers.**

GOSS ENGINEERING Co., Chicago.—Pamphlet illustrating and describing water tube boilers.

LYON BROTHERS BOILER Co., Chicago.—Pamphlet illustrating and describing water tube boilers. 4 by 9 in.; pp. 16.

**Cement Making Machinery.**

POWER AND MINING MACHINERY Co., Cudahy, Wis.—Catalogue No. 2, illustrates and describes machinery for the production of Portland cement by either the wet or dry process. 6 by 9 in.; pp. 86.

**Chemists' Supplies.**

E. H. SARGENT & Co., Chicago.—Cloth-bound catalogue and price list of chemical apparatus and assayers' materials. Fully indexed. 7 by 10 in.; pp. 238.

**Clutches.**

AKRON CLUTCH Co., Akron.—Booklet containing an illustrated description of friction clutches, together with tables giving dimensions, prices, etc. 3½ by 6 in.; pp. 18.

**Coal Handling Machinery.**

JEFFREY MANUFACTURING Co., Columbus.—Bulletin illustrating a number of installations of coal and ashes handling machinery in power plants made by this company. 6 by 9 in.; pp. 16.

**Controllers.**

ELECTRIC CONTROLLER & SUPPLY Co., Cleveland.—Bulletin No. 107 treats of type G controllers from 1 to 50 horse-power. Illustrated. 5 by 7½ in.; pp. 18.

**Countershafts.**

SPEED CHANGING PULLEY Co., Indianapolis.—A number of loose sheets describing speed changing transmission countershafts.

**Cranes.**

CRAIG RIDGWAY & SON Co., Coatesville, Pa.—

Catalogue treating balanced steam-hydraulic cranes. Also a pamphlet devoted to elevators. Illustrated. 9 by 6 in.; pp. 60.

**Crucibles.**

JOSEPH DIXON CRUCIBLE CO., Jersey City.—"Crucibles; Their Care and Use," is the title of one of the most comprehensive books ever published on the subject of graphite crucibles, which are also known as plumbago and black lead crucibles. Illustrated. 6 by 9 in.; pp. 42.

**Digging Machinery.**

HAYWARD CO., New York.—Booklet illustrating and describing dredges, derrick fixtures, railroad excavators, steel traveling derricks, coal hauling machinery and orange-peel and clam-shell buckets. 6 by 3½ in.; pp. 24.

**Drilling Machines.**

A. D. QUINT, Hartford.—Illustrated catalogue describing vertical turret drilling, tapping and chucking machines. 6 by 9 in.; pp. 24.

**Fireproof Windows.**

W. H. MULLINS CO., Salem, Ohio.—Catalogue No. 1 illustrates and describes sheet metal fireproof windows. Also contains illustrations of buildings on which they have been installed. 6 by 9 in.; pp. 32.

**Foundry Supplies.**

J. D. SMITH FOUNDRY CO., Cleveland.—Catalogue and price list No. 37 treats of foundry facings, supplies and equipment. 6 by 9 in.; pp. 260.

**Flue Welders.**

DRAPER MANUFACTURING CO., Port Huron, Mich.—Pamphlet illustrating and describing pneumatic flue welders for welding all sizes of flues up to 4½ in. 6 by 9 in.; pp. 6.

**Gasoline Engines.**

CHALLENGE CO., Batavia, Ill.—Catalogue devoted to an illustrated description of gasoline engines. 6 by 9 in.; pp. 32. Also two pamphlets treating of windmills and pumps.

**Gate Valves.**

DARLING PUMP & MFG. CO., LTD., Williamsport, Pa.—Bulletin No. 6 illustrates and describes gate valves with double revolving gate discs, compound equalizing wedges and parallel seats. 6 by 9 in.; pp. 42.

**Gold Dredging Machinery.**

RISDON IRON WORKS, San Francisco.—Catalogue No. 17 illustrates and describes a full line of gold dredging machinery, and is especially adapted to extracting gold from ancient riverbeds. 6 by 9 in.; pp. 60.

**Hack Saws.**

WEST HAVEN MFG. CO., New Haven.—Catalogue illustrating and describing hack saws and saw blades. 6 by 9 in.; pp. 16.

**Hoisting Engines.**

J. S. MUNDY, Newark.—Illustrated catalogue descriptive of contractors equipage of all descriptions for hoisting and handling material. 11 by 8 in.; pp. 86.

**Ice Making Machinery.**

ARCTIC ICE MACHINE CO., Canton, O—Catalogue 19 B illustrates and describes ice making and refrigerating machinery. 6 by 9 in.; pp. 32.

**Lathes.**

SEBASTIAN LATHE CO., Cincinnati.—Illustrated catalogue No. 10, with price list, describing engine and foot lathes and attachments. 6 by 9 in.; pp. 40.

RAHN-CARPENTER CO., Cincinnati.—Illustrated catalogue describing engine, turret, gap and pan lathes, together with specifications. 6 by 9 in.; pp. 52.

**Locomotives.**

DAVENPORT LOCOMOTIVE WORKS, Davenport, Iowa.—A number of loose-leaf sheets treating of different classes of locomotives.

AMERICAN LOCOMOTIVE CO., New York.—Catalogue illustrates and describes small locomotives, both steam and compressed air, for special classes of service for which ordinary road or yard engines are unsuitable. 9 by 6 in.; pp. 76.

**Machine Saws.**

H. T. STOREY, Chicago.—Leaflet giving capacity, dimensions, etc., of draw-cut machine saws. Illustrated. 6 by 9 in.; pp. 4.

**Machinists' Tools.**

J. WYKE & CO., East Boston, Mass.—Catalogue and price list of machinists' tools. 6 by 9 in.; pp. 12.

**Mining Cars.**

JACKSON MFG. CO., Harrisburg.—Folder illustrating and describing mining cars, steel barrows, wire rope thimbles, etc. 3 by 5½ in.; pp. 24.

**Mining Drills.**

HOWELLS MINING DRILL CO., Plymouth, Pa.—Catalogue illustrating and describing mining drills of every description. 6 by 9 in.; pp. 80.

**Mining Machinery.**

HENDRIE & BOLTHOFF MFG. & SUPPLY CO., Denver.—Catalogue No. 15 illustrating and describing mining, milling, machine shop and power plant equipment. 6½ by 10 in.; pp. 240.

**Molding Machines.**

E. H. MUMFORD CO., Philadelphia.—Loose-leaf catalogue illustrating and describing molding machines. 6 by 9 in.; pp. 32.

**Nut and Bolt Machinery.**

WATERBURY FARREL FOUNDRY & MACHINE CO., Waterbury.—Catalogue, section A, treating of automatic nut, bolt and rivet machinery, with specifications. Illustrated. 6 by 9 in.; pp. 78.

**Oil Cups.**

BAY STATE STAMPING CO., Worcester.—Leaflet illustrating and describing oil cups and oil-hole covers. 6 by 3 in.; pp. 8.

**Pipe Threading Machinery.**

MERRELL MFG. CO., Toledo.—Catalogue giving an illustrated description of pipe threading and cutting machinery, together with price list and dimensions. 6 by 9 in.; pp. 32.

**Pulleys.**

ONEIDA STEEL PULLEY CO., Oneida, N. Y.—Booklet illustrating and describing steel pulleys. 6 by 3½ in.; pp. 20.

**Pumping Machinery.**

HILL MACHINE CO., Anderson, Ind.—Illustrated catalogue describing pumping machinery to be operated by steam, electricity, gas or gasoline, etc. 6 by 9 in.; pp. 60.

CARLIN MACHINERY & SUPPLY CO., Allegheny.—Bulletins treating of power trench pumps and vacuum steam pumps. Also a bulletin devoted to gas or gasoline hoisting engines.

**Pump Regulators.**

MASON REGULATOR CO., Boston.—Well-printed catalogue illustrating and describing automatic regulating devices for steam, electric and power pumps. 6 by 9 in.; pp. 56.

**Rock Drills.**

INGERSOLL-RAND CO., New York.—Catalogue No. 46 contains an illustrated description of rock drills for mining, tunneling and general rock excavation. 6 by 9 in.; pp. 84.

**Screw Cutting Tools.**

WELLS BROS. CO., Greenfield, Mass.—Catalogue No. 22 illustrates and describes taps, dies, screw plates, bolt cutters, nut tappers, reamers, gauges, special tools, etc., together with tables giving sizes and prices. 5 by 7¼ in.; pp. 252.

**Stamp Mills.**

JOSHUA HENDY IRON WORKS, San Francisco.—Bulletin No. 101 treats of quartz and gravel stamp mills with triple and quadruple discharge mortars. 6 by 9 in.; pp. 16.

**Steam Engines.**

LANE & BODLEY CO., Cincinnati.—Catalogue containing a brief illustrated description of Corliss engines. 9 by 6 in.; pp. 26.

**Steam Hammers.**

ERIE FOUNDRY CO., Erie.—Loose-leaf catalogue containing illustrated description of steam hammers. 6 by 9 in.; pp. 8.

**Steam Specialties.**

KLIPFEL MFG. CO., Chicago.—Catalogue illustrating and describing pressure regulators, valves, steam traps, etc. 5 by 7 in.; pp. 24.

**Steam Traps.**

MOREHEAD MFG. CO., Detroit.—Catalogue containing an illustrated description of tilting return steam traps. Also contains a price list. 3½ by 8 in.; pp. 16.

**Steel and Iron.**

MILLIKEN BROTHERS, New York.—Large catalogue, with flexible leather cover, containing information and tables relative to steel, iron and other products for buildings and bridges. 11 by 7 in.; pp. 448.

**Stokers.**

AMERICAN STOKER CO., Erie.—Catalogue devoted to an illustrated description of automatic underfeed stokers and accessories for steam plants, furnaces, etc. 6 by 9 in.; pp. 56.

**Storage Batteries.**

WESTINGHOUSE MACHINE CO., East Pittsburg.—Catalogue 5 illustrating and describing storage batteries for stationary service. 6 by 9 in.; pp. 32.

**Tachometers.**

VEEDER MFG. CO., Hartford.—Folder illustrating and describing tachometers for indicating revolutions per minute. Also a booklet treating of counting machines.

**Telephones.**

HOLTZER-CABOT ELECTRIC CO., Boston.—Booklet illustrating and describing interior telephones for offices, factories, etc. 6 by 3½ in.; pp. 24.

**Threading Tools.**

BORDEN CO., Warren, O.—Catalogue illustrating and describing threading tools for pipe and bolts for both hand and power. 5 by 7½ in.; pp. 16.

**Tool Grinders.**

GISHOLT MACHINE CO., Madison, Wis.—Well-printed catalogue illustrating and describing tool grinders. 8 by 10 in.; pp. 24.

**Traction Ditcher.**

BUCKEYE TRACTION DITCHER CO., Findlay, O.—Booklet illustrating and describing traction ditchers. 6 by 8½ in.; pp. 28.

**Traveling Cranes.**

READING CRANE & HOIST WORKS, Reading, Pa.—Catalogue illustrating and describing traveling cranes. 9 by 6 in.; pp. 32. Also a pamphlet treating of chain hoists. 6 by 9 in.; pp. 16.

**Turbine Water Wheels.**

S. MORGAN SMITH CO., York, Pa.—Well-printed catalogue descriptive of turbine water wheels and power transmitting machinery. 5 by 7½ in.; pp. 124.

**Valves.**

RENSSELAER MFG. CO., Troy.—Catalogue illustrates and describes valves and gates for water, gas, steam, oil, etc. 9 by 6 in.; pp. 184.

**Vertical Engines.**

AMERICAN BLOWER CO., Detroit.—Catalogue No. 206 treats of vertical self-oiling steam engines. Illustrated. 7 by 9 in.; pp. 60.

B. F. STURTEVANT CO., Boston.—Bulletin No. 125 illustrates and describes vertical forced-lubrication enclosed engines in eighteen different sizes ranging from 5 x 5 to 12 x 10. 6 by 9 in.; pp. 8.

**Voltmeters.**

WESTON ELECTRICAL INSTRUMENT CO., Waverly Park, Newark.—Bulletin No. 7 illustrates and briefly describes electroplaters' voltmeter, model 131. 8 by 10½ in.; pp. 4.

**Water Towers.**

CHICAGO BRIDGE & IRON WORKS, Chicago.—Catalogue illustrating and describing water towers, tanks, stand pipes, smokestacks, etc. 4½ by 7¼ in.; pp. 64.

**Water Turbines.**

TRUMP MFG. CO., Springfield, O.—Catalogue illustrating and describing turbines for low and medium heads. 9 by 6 in.; pp. 80.

**Wood-Working Machinery.**

CRESCENT MACHINE CO., Leetonia, O.—Catalogue illustrating and describing band saw machines, band saw blades, saw tables, and jointers. 4¾ by 6¾ in.; pp. 34.

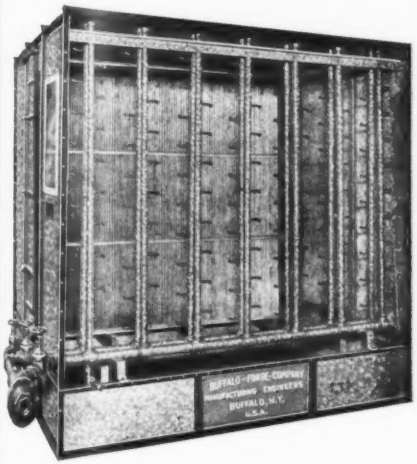
# IMPROVED MACHINERY

## New Processes and Appliances

*The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.*

### Buffalo Air Washer and Humidifier.

THE attention of architects has been brought most forcibly within the last few years to the great advantages derived from air cleansing when applied to buildings through ventilation systems. A few years ago installations of this character were regarded as curiosities, but within the last few years it has been the custom rather than the exception to provide some means of removing the solid matter held in suspension in the air entering large public or office buildings and fine residences. It is obvious that the need of such devices is most urgent where the fan system of heating and ventilating is used, or where the air is secured through an intake on the level with the pavement, or where smoke or street dust prevails in the atmosphere surrounding a building. It has been discovered that the relative humidity of the atmosphere should be between 50 and 70 per cent., that is, normal to the human body. If 50 per cent. is maintained within a heated building a great saving in the number of percentage required will result. This latter is because lower dry bulb temperature would be necessary to give equal sensible temperature and sense of physical comfort. Therefore, in connection with the problem of air cleansing we might add that the problem of properly humidifying or regulating the moisture content of the air goes hand in hand with the fan system of heating and ventilating. If the methods be reviewed by which air cleansing has been attempted, the development can be traced through cheese cloth screens on wooden frames, coke screens with a trickle of water over them, burlap screens, some wet, some dry, some arranged as a moving belt dipping into a water bath, others stationary with a water trickle or spray playing on them, and finally to the latest water spray and atomizing washers. The objection to cloth filters and coke screens is that they occupy too much space due to the low air velocity which can be allowed owing to the high friction which is imposed in drawing the air through them. Coke screens and burlap belt gives fair results as far as cleansing, but they require much space, and in any event the steam is not automatic and the apparatus must be made to order for the architect—each having his own particular notion as to proportions, etc. It is common with all air cleansers to pass the air taken from the intake through the filter, whatever type may be used, then to the fan and through the heater if it be a "blow-through" type. or through the fan if the arrangement be of the "draw-through" type.




In the Buffalo air washer it is common to pass the air taken from the intake first through tempering coils which in winter raise the temperature 60 to 70 degrees, thus preventing the freezing of water in the washing chamber. The air then enters the washer and is thoroughly sprayed by a system of nozzles ejecting from 2½ to 4

pounds of water per minute in the direction of air travel. The number of nozzles used may be from two to sixteen per square foot of cross section of the washing chamber. Usually the washing chamber is about four feet long, though in special cases where humidity control is of more importance than air cleansing this chamber may be made longer in order to obtain full benefit of the contact between the air and the water surface of the spray. The nozzles used on the Buffalo air washer are of a most peculiar type, in which the water is actually atomized by centrifugal force (due to the construction of the nozzle, which gives the spray a rotating motion) rather than being thrown in flat jets as in other air washers. After the spray water has performed its function of cleansing, moistening or cooling the air, it is necessary that all free particles of water, together with impurities be removed from the air current, yet at the same time no perceptible resistance must be offered to the air passage which will interfere with the ventilation and perfect action of the fan. This is accomplished by the eliminator, which consists of a series of vertical baffle plates, which on the farther edge are provided with little vertical gutters that break the continuity of the water film, and prevent its being blown from the back edge of the plate through the heater. The eliminator plates are galvanized, though in special cases they may be constructed of sheet copper. One great advantage of the eliminator plates used in the Buffalo air washer is that they are fastened together with a steel frame work which keeps them rigidly in shape and preserves the exact spacing required between the plates, not only at the top and bottom, but at intermediate points. The eliminator is self-contained, and when it leaves the factory it is ready to be set in place without any work except that of removing the boxing, a very apparent advantage over any form of eliminator which is composed of loose unsupported parts which are easily bent out of shape. The particular functions of the eliminator may be named as two: first, it presents a water surface to the passing air to which all solid particles not wet down by the spray will adhere; second, the vertical gutters, or lip-like projections, previously described, prevent any free moisture from reaching the fan and being forced on into the building. Though the spray system may be operated directly from city pressure, it is common, except in the smaller sizes, to pump the water over and over until it becomes unfit for use. Rapid evaporation requires a supply of fresh water which is provided by a float valve in the settling tank. A small motor driven centrifugal pump is quite able to supply the necessary pressure and quantity of water required by the sprays.

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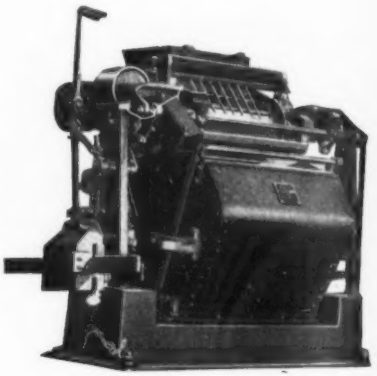
### Automatic Weighing Machines.

THE Automatic Weighing Machine Co. has recently moved into its new building, at Newark, N. J. This company owns about 350 patents pertaining to automatic weighing machines, and the machines are constructed specially for a great variety of users, but perhaps the largest demand for automatic weighing machines from any one industry comes from the cement manufacturer. The special automatic weighing machines used in cement manufacture have been developed by the company in step with the development of that industry.



The automatic weighing machines used by cement makers not only weigh out the manufactured product and deliver it to the bag or barrel into which it is packed for the market, but they also weigh the percentage of limestone, clay, marl or shale stone the manufacturer uses for roasting

or grinding. The great usefulness of these machines to the cement manufacturer exists in the fact that no cement can be manufactured by rule of thumb, each consignment of material, whether of clay or rock, must be analyzed and the correct percentage thereof ground up together to make a cement that will stand the tests to which cements must be subjected for all important construction work. These percentages are accurately measured and weighed by the automatic machines when determined by the analysis, the only necessity being that the operator shall fix the pointer on his scale beam to the mark designated.

With few exceptions all the machines made by the Automatic Weighing Machine Company are leased to the manufacturer who uses them. The company installs the machines, puts them in running order and maintains them in operation on a royalty basis much as the United Shoe Machine Company leases its machines for the manufacture of boots and shoes. The machines, however, may be purchased outright if the manufacturer so desires.

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### Interlocking Rubber Tiling.

MUCH of the credit for the enormous increase in popularity of interlocking rubber tiling is due to the Pennsylvania Rubber Company, of Jeannette, Pa., who entered this field with a new and simplified arrangement of interlocking rubber tiles a few years ago. Appreciation of the wide variety of uses to which this material could be successfully applied led the company to exploit its product vigorously, with the result that at present there is scarcely any class of building in which it is not found. Some idea of the scope of its usefulness may be gathered from the fact that it may be seen upon the floor of one of the finest cathedrals in the country, and in one of the largest of the public art galleries, and at the same time in many kitchens, vestibules and bathrooms of the well-to-do. The advantages claimed for this interlocking rubber tiling are so many and general that space does not permit their enumeration, but it is said to outwear even marble, to form an absolutely waterproof surface, and to be so easily applied that any workman of ordinary skill can lay it successfully, though he may be previously inexperienced with it. Ocean liners, lake steamers, ferryboats and yachts are large users of this tiling because of its non-slippery character, and the fact that it remains unaffected by constant wrenching strains. As flooring for elevators it is also popular for the same reasons.

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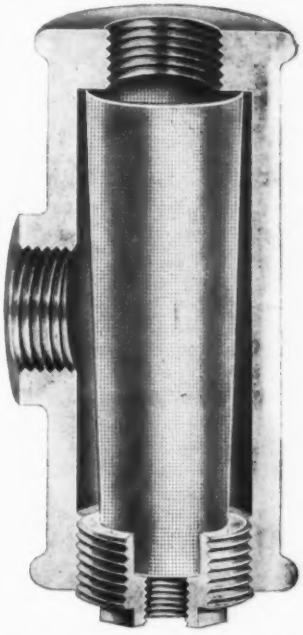
### The Wright Filter.

THE accompanying illustration shows the "Wright" filter, a new appliance, at low cost, for the elimination of all foreign matter, such as sand, scale, vegetable and floating substances of minute or large proportions, from water pipes, boilers, meters or any device to which water is fed



through pipes. It will be noted that this filter is simple in design, compactly constructed and contains no complications to cause trouble after installation. The outer cylindrical casing contains a circular conical tube screen of much larger area than the opening at inlet. This screen is secure-

ly fastened to a plug which is screwed into outlet at the lower end of the device and may be removed in an instant by simply unscrewing the plug. A blow-off valve attached to this plug will, if occasionally opened, serve to keep the filter free from accumulated matter which is retained in the screen and precipitated to the bottom thereof.

The manufacturers claim the Wright filter enjoys its present state of efficiency under the original design, but in keeping with customary policy sufficient time has been allowed for many and varied tests to which it has been subjected and in every case the results have proven highly satisfactory. The Wright promises to become popular with institutions requiring the use of a large number of efficient filters at a nominal cost. The filter is made in six sizes, being governed by diameter of inlet pipe and ranging from one to three inches, or special sizes for special purposes. The device is manufactured by the Wright Manufacturing Co., 26 Woodbridge Street, Detroit, Mich.

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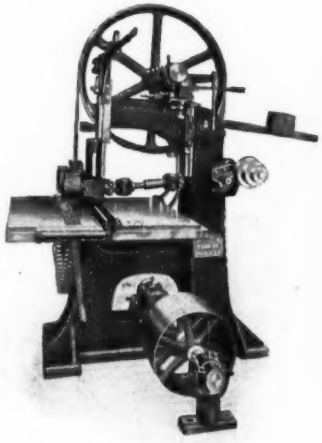
**Combination Band Rip and Edging Saw.**

THE accompanying illustration shows a new combination band rip and edging saw. For edging, the table is provided with a traveling chain under the out-feeding roll, as shown in Illustration and is operated by a sprocket chain and gearing from the same shaft that runs the upper-feed-rolls. This traveling chain has a vertical adjustment and can be quickly dropped below the surface of the table to be out of the way for ripping. The column is very heavy, cored and perfectly free from vibration. The distance between the fence and the saw blade will admit material up to 24 inches wide. The rolls may be raised to receive timber 12 inches thick. The table is of ample size, and has, at the front, a plainly stamped index. Idler rolls are fitted in the table to remove friction. A cam lever releases, moves and clamps the fence, accomplishing the adjustment of the fence more quickly than by any other means yet devised. The wheels are 42 inches in diameter, entirely of iron and steel, with spokes; the lower, heavy and with solid web, circulating less dust and sustaining great momentum, so that its speed governs that of the upper, preventing the latter overrunning the former. The wheel shafts are of steel, especially heavy, running in extra long self-oiling bearings. The straining device (controlling the upper wheel and the path of the saw blade on the face of the wheels) is new and very sensitive and has a forward, backward and



also a side adjustment. It is regulated by an adjustable weight and a compound lever so sensitive that no matter what the vibrations are the strain takes up the slack in the blade instantly, adding wonderfully to the perfect working of the machine and the life of the saw blade. The saw guides are the latest improved pattern with sectional hardwood blocks arranged to permit of taking up the slightest wear and perfectly guiding the blade in the plane of the cut. There are three speeds of feed, 30, 60 and 125 feet per minute. Faster feeds will be furnished when desired. The feed is very powerful, the driven feeding-in and feeding-out rolls placed close together, enabling short stock to be worked to advantage. They are adjustable up and down instantly by means of the long lever above, convenient to the operator, or they may be raised from the board, instantly stopping the feed, or lifted quickly out of the way for use as a hand feed rip saw, all of which may be accomplished by a single

movement of the long lever. The feeding-out roll bearing is adjustable to take up the slack in the driving chain.

For further information regarding this tool, write the manufacturers, J. A. Fay & Egan Co., *212-232* West Front Street, Cincinnati, O.

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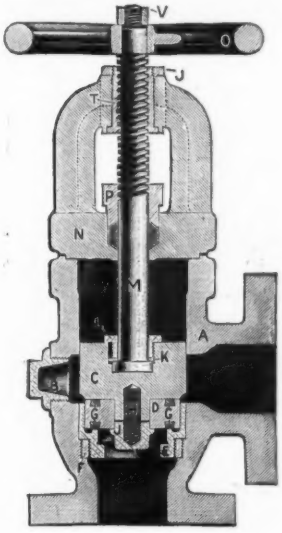
### An Improved Blow-off Valve.

THE cut herewith fully illustrates an improved design of blow-off valve, which embodies a number of important features highly appreciated by users. Heretofore the seat was so located that as the disc approached the same, there would be an accumulation of scale and sediment. The effect of this accumulation would be




to cut the bearing surfaces to such an extent that in a short time the valve would become leaky. Various methods have been invented whereby the disc would fit tightly in the valve body, the object being to prevent the scale from passing on to the seat bearing after the disc had passed and cut off the inlet. This method, however, has not proved satisfactory, as the valve would soon wear, and in a short time, permit the passage of scale and sediment. These defects have been overcome in this improved design blow-off valve. The plug fits snugly in a separate and easily removable bronze casing, which can be readily replaced when worn. Any accumulation of scale or sediment that might remain on the seat before the disc is brought in contact with same, is washed off by the water which passes around the plug when seating. It will be seen that the plug C carries a reversible, double-faced disc D, secured to the plug by a stud and nut. This plug is guided perfectly in the valve body. The bronze seat ring is screwed into a second brass ring, F, the object being to make it possible to renew the seat ring very easily when worn. At the back of the valve is a plug, B, the use of which is to permit the introduction of a rod to clean out the blow-off pipe when desirable. The stem which raises and lowers the disc is held in place by lock-nut which is prevented from unscrewing by a non-rotating washer. The threads of the stem operate within the bronze bushing in the top of the yoke, which bushing can easily be removed.

It will be seen from this description that all parts of the valve have been so designed that they can be easily renewed when worn or broken. The disc, having two Babbitt-faced bearings, can be replaced at small cost, or the user of the valve can melt out the old Babbitt and pour in new metal, and after this is faced off, the disc is as good as new. When it is desirable to close the Duro valve in operation, the disc is screwed down in the usual manner. As the edge of disc approaches the cylindrical extension these edges shear and cut off any scale or sediment which might pass. As the disc continues to approach the seat bearing the leakage of water around it will effectually wash off any scale or sediment which might have accumulated. The result of this is that when the disc is perfectly seated no scale or sediment can remain between the bearings. As the seat and disc ring can be removed very easily and at small cost, it will be plain that the valve is very durable and will last indefinitely. This article, known by the trade name of "Duro," is constructed of the very best materials and carefully tested by The Lunkenheimer Company.

### Buckets for Handling Broken Stone.

ALMOST every day we read in the technical papers of gigantic engineering works in which thousands of yards of concrete are used, necessitating the handling of large quantities of cement, sand and broken stone. The cement and sand can readily be handled, but the prob-

lem of unloading broken stone from cars or barges is not so readily solved. Both the cement makers, using large quantities of broken stone, and the cement users, requiring stone of smaller sizes, are beginning to recognize the value of grab buckets as a means for handling broken stone and sand in a rapid and economic manner. We illustrate here a modern plant, owned and operated by the Cosmos Portland Cement Company of Cosmosdale, Ky., for handling large quantities of stone from barges to storage bins, from which it is spouted into cars as desired. This revolving derrick is of steel construction and is mounted upon a concrete pier as shown. The mast is 92 feet high and the boom 75 feet long. Hoisting and slewing are accomplished by separate engines, the former being an 8" x 8" and the latter 6" x 6". The rig is equipped with a Jeffrey Class "B" grab bucket, especially designed for handling material of this kind. Another view shows the bucket ready to take its bite, and, as will be noted, the span is large, and the bucket will fill itself to capacity in a shallow depth of material. A third illustration shows the bucket closed and carrying its load to the storage bin. This bucket can unload a thousand ton barge in about ten hours and will handle in a satisfactory manner stone up to 4" cubes. Stone can also be handled from cars by means of this bucket, 90 per cent. being cleaned up without the least damage to car, no hand shoveling being necessary.

This bucket is of heavy design to withstand the hard usage to which it is subjected. All castings are of steel, all sheaves are machine grooved and have hard bronze bushings. The scoops are of heavy steel, well reinforced with angle braces. The scoops are provided with reinforcing lips, which may be replaced with new ones when worn out. All pins are of cold rolled steel, accurately machined and fitted, the form pins, the only ones liable to abrasion from coming in contact with sand, being of hardened steel running in

hard tempered tubing, and show but little wear after a season of hard usage. The Jeffrey Mfg. Co., of Columbus, Ohio, are prepared to build this bucket in any desirable size, and will design, build and erect rigs for the handling of same.

# NEWS SUPPLEMENT

The Engineering Magazine—May, 1907

### Personal.

—Theodore D. Buhl, president of the Buhl Malleable Co., and the Buhl Stamping Co., Detroit, died recently from apoplexy while in New York.

—J. H. Dohner, for a number of years with the National Cash Register Co., has accepted a position as assistant general superintendent with The National-Acme Manufacturing Co., Cleveland.

—Edward W. De Knight, manager of the Hydrex Felt & Engineering Co., New York, sailed on the S. S. Hamburg, March 30th, on an extended European trip via the Mediterranean.

—E. M. McIlvain, formerly president of the Bethlehem Steel Co., has been elected president and general manager of the Robins Conveying Belt Co., Park Row Building, New York.

—Gardner Cornett has recently been elected vice-president of the American Steam Gauge & Valve Manufacturing Co., his office being located at the headquarters of the company, 220 Camden Street, Boston.

—William S. Johnson, for the past twelve years the assistant engineer of the Massachusetts State Board of Health, announces that he has opened an office at 101 Tremont Street, Boston, for the practice of civil Engineering.

—Robert C. Shaal, formerly with the General Storage Battery Co., New York, has accepted the position of sales engineer of the Bliss Electric Car Lighting Co., with headquarters at the company's New York office, Fifth Avenue and 44th Street.

—F. A. Molitor has resigned the position of supervising railway expert to the Philippine Government, his resignation taking effect April 1st, upon which date he left Manila, P. I., and will return to the United States during the fall, spending the interim in China, British India and on the Continent. After leaving Manila, P. I., Mr. Molitor can be addressed in care of the University Club, Philadelphia.

### Industrial Notes.

—The Ball Engine Co., Erie, Pa., builders of automatic and Corliss engines, has opened a branch office at 1213 Chemical Building, St. Louis, under the management of O. L. Collins.

—The Seely-Taylor Co. announces that its business has been merged with a new corporation under the title of Maritime Dredging Co., which will continue the business of the old corporation at 78 Broad St., New York.

—The Ball Engine Co., Erie, Pa., announces that it has opened a branch office at 39 Cortlandt St., New York, for the sale of its automatic and Corliss engines. This office will be under the management of Lancelot Copleston.

—The New Electrical Engineering Building of Worcester Polytechnic Institute, which will be the largest one of its kind in the country, costing over $125,000, is to be equipped with a complete heating and ventilating outfit supplied by The Green Fuel Economizer Co., Matteawan, N. Y.

—B. F. Sturtevant Co., Boston, has just received from the Interborough Rapid Transit Co. a repeat order for standard economizers. The previous order was for the equipment of 26,000 boiler horse power. The total number of tubes to complete both orders will be 11,200.

—The New York branch of the Green Fuel Economizer Co. has removed to the new West Street Building, No. 90 West Street. The new offices will be considerably larger than the old, in order to take care of the increasing business in economizers, fans, blowers and exhausters.

—Sales are reported of Sturtevant high pressure rotary type blowers to Otis Elevator Co., Chicago; The Macallen Co., South Boston; United Oil & Refining Co., Beaumont, Texas; Lumsden & Van Stone Co., Boston; Johnson & Blanding, Providence; and Sharpless Separator Co., West Chester, Pa.

—Alberger Pump Co. has been organized to manufacture and sell centrifugal and turbine pumping machinery embodying novel and important improvements. The main office is located at 95 Liberty St., New York, with a branch office at 205 La Salle St., Chicago.

—The Locke Regulator Co., Salem, Mass., manufacturers of the Locke engine stop and speed limit system, have just won the suit for infringement brought against them by the Consolidated Engine Stop Co. under the "Stannard" patent. No engine stops had ever been manufactured under it. Suit was brought against one of the customers of the Locke Regulator Co.

—The Le Naire Advertising Co. announce their removal to 150 Nassau St., New York, where they will continue to write and design advertisements, circulars, booklets, catalogues and other printed matter for engineering and machinery firms. Lewis T. Le Naire, manager of the above company, has had a wide experience in this kind of advertising.

—The Banning Co., heretofore known as Bruce & Banning, has been incorporated under the laws of the State of New York. The policies and methods of operation will be the same as those employed by the latter company. On May 1st they will move from their present offices to the Brunswick Building, 225 Fifth Ave., New York, where larger quarters have been secured.

—The Crocker-Wheeler Co., whose main office and works are at Ampere, N. J., has found it impossible to handle its rapidly increasing business in electric motors and generators in Birmingham, Ala., from its New Orleans and Baltimore offices, and has been obliged to establish headquarters in Birmingham. The new office which is in the Woodward Building, Birmingham, is in charge of B. A. Schroder, who hitherto has taken care of the New Orleans territory of the company.

—The Cleveland-Cliffs Iron Co. has placed an order for a 60-drill Sullivan air compressor for its new Maas Mine at Negaunee, Mich. The machine will be of the Corliss cross compound condensing two stage type, with large receiver intercooler. The steam cylinders will be 24 x 46 inches in diameter, with a 48-inch stroke, and the air cylinders 40 x 24 x 48 inches, with a displacement capacity of 4,000 cubic feet of free air per minute at 60 R. P. M., or nearly 5,000 feet at 70 R. P. M. The compressor will be built at the Chicago works of the Sullivan Machinery Co.

—The Casualty Co. of America is now writing fly-wheel insurance in addition to its other lines. They are placing on the market an excellent contract covering certain features original with this Company. In addition to the ordinary covering of property, loss of life and personal injuries, they have added the additional features of indemnity daily loss of profit and income as the result of fly-wheel explosions. This very broad policy should enable this Company to obtain a large number of risks in this particular line of casualty insurance.

—Electro Metallurgical Co., with general offices at 157 Michigan Ave., Chicago, and branch offices at 79 Wall St., New York, was incorporated about six months ago, and began the manufacture at Niagara Falls, N. Y., of high-grade ferro-alloys, and at which point they are now installing additional equipment for materially increasing its output. The Willson Aluminum Co.'s works and business have been sold and transferred to the Electro Metallurgical Co., and the latter company are now adding to its Kanawha Falls, W. Va., works with the intention of increasing its capacity and output of ferro-alloys, particularly ferro-chromium and ferro-silicon.

—On May 1st the Chicago branch of Niles-Bement-Pond Co. will occupy their new offices on the sixth floor of the new Commercial National Bank Building, Clark and Adams Streets, Chicago. Pratt & Whitney Co. will abandon their show room and offices at 46-48 South Canal Street, and will combine their machinery sales department with that of Niles-Bement-Pond Co. The show room and stock of Pratt & Whitney small tools, and the small tools sales department, will be located on the ground floor of the new Plamondon Building, Clinton and Monroe Streets, where a complete line of Pratt & Whitney small tools and gauges will be carried in stock. Geo. F. Mills, who has for several years looked after the interests of these companies in the Chicago territory, will continue as manager of the Chicago office.

# NEW CATALOGUES AND TRADE PUBLICATIONS

*These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.*

**Air and Gas Compressors.**

INGERSOLL-RAND CO., New York.—Catalogue H 56 is devoted to an illustrated description of duplex steam driven air and gas compressors. 6 by 9 in.; pp. 64.

**Blue Print Machines.**

J. H. WAGENHORST & CO., Youngstown.—Booklet containing a brief illustrated description of electric blue print machines. Also contains numerous testimonial letters from users. 6 by 4 in.; pp. 36.

**Boiler Tube Cleaner.**

LAGONDA MFG. CO., Springfield, O.—An illustrated treatise on boiler scale and its removal. Also illustrates and describes the "Weinland" mechanical boiler tube cleaner and other steam specialties and their application. 6 by 9 in.; pp. 48.

**Buckets.**

HAYWARD CO., New York.—Booklet containing illustrations and price list of orange-peel and clam-shell buckets. 6 by 3½ in.; pp. 18.

**Car Wheels.**

LOBDELL CAR WHEEL CO., Wilmington.—Catalogue illustrating and describing self-oiling mine railway wheels. 6 by 9 in.; pp. 24.

**Conveying Machinery.**

JEFFREY MFG. CO., Columbus.—Catalogue No. 57 B illustrates and describes conveying machinery for saw mills, lumber mills and wood-working industries. Also contains views of many actual installations. 6 by 9 in.; pp. 72.

**Cooling Towers.**

ALBERGER CONDENSER CO., New York.—Catalogue No. 7 treats of the application and advantages of cooling towers. Condensers, pumping engines, vacuum pumps, heaters, expansion joints, and centrifugal pumps are also given a place. Illustrated. 6 by 9 in.; pp. 32.

**Corundum Wheels.**

CORTLAND CORUNDUM WHEEL CO., Cortland, N. Y.—Illustrated catalogue describing corundum wheels. 6 by 9 in.; pp. 60.

**Engineering Instruments.**

A. WISSLER INSTRUMENT WORKS, St. Louis.—Cloth bound illustrated catalogue treating of engineering and surveying instruments, together with prices. 6 by 9 in.; pp. 58.

**Folding Rules.**

KEUFFEL & ESSER CO., New York.—Folder illustrating and describing folding pocket rules, together with prices. Also circular devoted to illustrated descriptions of pocket calculators and automatic print hangers.

**Gas Engines.**

REIERSON MACHINERY CO., Portland, Ore.—Catalogue containing a brief general illustrated description of gas engines, together with tables giving sizes, weights, prices, etc. 9 by 6 in.; pp. 66.

**Gauges.**

JOHN M. ROGERS BOAT, GAUGE AND DRILL WORKS, Gloucester City, N. J.—Catalogue illustrating of ignition and sparking batteries, together with prices. 6 by 9 in.; pp. 42.

**Gears.**

SAWYER GEAR WORKS, Cleveland.—Catalogue and price list describing gear wheels and gear cutting of every description. 7 by 4 in.; pp. 36.

**Generating Sets.**

B. F. STURTEVANT CO., Hyde Park, Mass.—Bulletin No. 143 illustrates and describes generating sets with horizontal engines. This bulletin completes the group of publications in its Engineering Series relating to engines and generating sets. 6 by 9 in.; pp. 8.

**Grinding Wheels.**

NORTON CO., Worcester.—"Testing for Safety" is the title of a little booklet describing the system of testing grinding wheels to obviate any possibility of furnishing wheels containing flaws, or which may be weak or defective in any respect. 3½ by 6 in.; pp. 8.

**Hoisting Engines.**

MONIGHAN'S MACHINE WORKS, Chicago.—Catalogue devoted to an illustrated description of hoisting engines. 6 by 9 in.; pp. 46.

**Ice Making Machinery.**

BRUNSWICK REFRIGERATING CO., New Brunswick, N. J.—Catalogue illustrating and describing refrigerating and ice making machinery for the manufacture of ice and mechanical refrigeration. 6 by 9 in.; pp. 48.

**Ignition Battery.**

COMMERCIAL BATTERY CO., Chicago.—Booklet treating of ignition and sparking batteries, together with dimensions and prices. 3 by 6 in.; pp. 8.

**Industrial Cars.**

CHASE FOUNDRY & MFG. CO., Columbus.—Catalogue containing an illustrated description of industrial cars and trucks, together with tables giving sizes, prices, etc. 6¾ by 5 in.; pp. 56.

**Lathes.**

SPRINGFIELD MACHINE TOOL CO., Springfield, O.—Loose-leaf catalogue treating of lathes, shapers, boring machines, power presses, etc. Illustrated. 9 by 12 in.; pp. 30.

**Locomotives.**

AMERICAN LOCOMOTIVE CO., New York.—Catalogue devoted to the Mogul type of locomotive and illustrates and describes 25 different designs of this type built for various railroads.

The designs illustrated range in weight from 49,000 to 187,000 pounds. 9 by 6 in.; pp. 60.

BALDWIN LOCOMOTIVE WORKS, Philadelphia.—"The Actual Efficiency of a Modern Locomotive" is the title of a paper read before the Pacific Coast Railway Club by William Penn Evans, February 17, 1906. It compares the locomotives of the present day with those built twenty years ago. 9 by 6 in.; pp. 32.

**Metallic Packings.**

UNITED STATES METALLIC PACKING CO., Philadelphia.—Booklet illustrating and describing metallic packings for marine and stationary engines. 3¼ by 6 in.; pp. 16.

**Metal Saws.**

VANDYCK CHURCHILL CO., New York.—Catalogue illustrating and describing sawing and grinding machines. 6 by 9 in.; pp. 48.

**Metal Working Machinery.**

NILES-BEMENT-POND CO., New York.—Catalogue No. 13 contains a brief description of second-hand metal-working machinery which they have on hand. 4¾ by 7¼ in.; pp. 52.

**Mine Equipment.**

CHRISTMAN CO., Massillon, O.—Catalogue illustrating and describing mine equipment, miners' drills and drilling machinery for all purposes. 6 by 9 in.; pp. 82.

**Milling Machines.**

NEWTON MACHINE TOOL WORKS, Philadelphia.—Catalogue illustrating and describing milling machines and metal-working machinery. 6 by 9 in.; pp. 236.

**Mine Pumps.**

JANESVILLE IRON WORKS CO., Hazleton, Pa.—Catalogue illustrating and describing pumps for mine service. 6 by 9 in.; pp. 36.

**Motors.**

FIDELITY ELECTRIC CO., Lancaster, Pa.—Bulletin illustrating and describing direct current motors and generators. 6½ by 10 in.; pp. 8.

**Oil and Grease Cups.**

D. T. WILLIAMS VALVE CO., Cincinnati.—Advance circular illustrative and descriptive of oil and grease cups, which is very comprehensive in its variety. Also gives sizes and prices. Their 1907-8 catalogue is about ready for distribution, and will contain an illustrated description of a complete line of steam specialties, besides useful and graphic information of interest to the engineer.

**Pavement.**

METROPOLITAN PAVING BRICK CO., Canton, Ohio.—Pamphlet treating of vitrified brick as a pavement. Is well printed and contains views showing streets on which this block has been employed. 11 by 7 in.; pp. 58.

**Perforated Metals.**

CHAS. MUNDT & SONS, New York.—Booklet illustrating a few perforations in sheet metal, together with other information of a useful nature. 3¼ by 6 in.; pp. 48.

**Pipe Couplings.**

S. R. DRESSER MFG. CO., Bradford, Pa.—Catalogue illustrating and describing pipe fittings, clamps, sleeves and fittings for wrought and cast iron pipe. 6 by 9 in.; pp. 90.

**Planers.**

WOODWARD & POWELL PLANER CO., Worcester, —Well-printed catalogue illustrating and describing metal planing machines. 6 by 9 in.; pp. 96.

**Rubber Tiling.**

PENNSYLVANIA RUBBER CO., Jeanette, Pa.—Catalogue illustrating, in colors, many different designs of tiling for use in public buildings, banks, hotels, residences, steamships, etc. 7¼ by 9¼ in.; pp. 26.

**Screw Cutting Tools.**

OSTER MFG. CO., Cleveland.—Catalogue containing a brief description, with sizes and prices, of tools and machinery for threading pipe and bolts. 6 by 9 in.; pp. 36.

**Shapers.**

QUEEN CITY MACHINE TOOL CO., Cincinnati.—Leaflet giving a brief illustrated description of shapers. 6 by 9 in.; pp. 6.

**Steam Gauges.**

SCHAEFFER & BUDENBERG MFG. CO., Foxboro, Mass.—Catalogue treating of steam gauges. Illustrated. Also catalogues illustrating and describing steam engine indicators; separators for removing water and oil from steam; engine registers; electrical pyrometers; calorimeters; and brass goods and engineering specialties.

**Steam Road Rollers.**

KELLY-SPRINGFIELD ROAD ROLLER CO., Springfield, O.—Catalogue treating of steam road rollers. Illustrated. 10½ by 8 in.; pp. 32.

**Steam Traps.**

P. A. MOULTON, New York.—Circular illustrating and describing steam traps, together with tables giving prices, dimensions, etc.

**Steam Traps.**

KITTS MANUFACTURING CO., Oswego, N. Y.—Booklet briefly describing steam traps. Illustrated. 3½ by 6 in.; pp. 16. Also a folder treating of fan engine regulators.

**Testing Machinery.**

TINIUS OLSEN & CO., Philadelphia.—Catalogue illustrating and describing testing machinery and instruments for testing cement and concrete, rubber, leather, wire, etc. 8¼ by 10½ in.; pp. 40.

**Time Stamps.**

AUTOMATIC TIME STAMP CO., Boston.—Folder illustrating and describing model No. 2 automatic time stamp. 3½ by 6 in.; pp. 4.

**Track and Railway Supplies.**

BUDA FOUNDRY & MFG. CO., Chicago.—Catalogue, cloth bound, illustrating and describing track and railway supplies. 6 by 9 in.; pp. 268.

**Transmission Rope.**

WATERBURY CO., New York.—Booklet devoted to description of transmission rope, together with tables containing much valuable data. 3½ by 5½ in.; pp. 8.

**Unions.**

WESTERN TUBE CO., Kewanee, Ill.—Folder illustrating and describing unions.

# IMPROVED MACHINERY

## New Processes and Appliances

*The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.*

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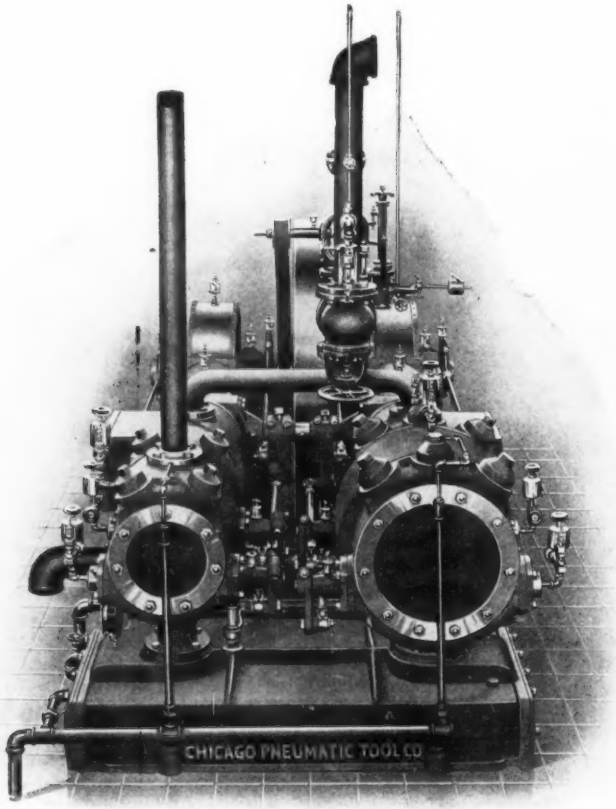
### The New Franklin Air Compressor.

THE Chicago Pneumatic Tool Company was among the first to produce a perfected line of pneumatic tools and appliances, and being manufacturers of machines using compressed air as a motive power, their attention was naturally attracted to the most efficient means of producing compressed air. These investigations eventually led to their entry into the field of compressor manufacture, enabling the company to offer complete equipment of its own make. Despite the fact that there are more than 2,000 Franklin compressors and 60 to 70 compressors per month are now being turned out, many are not aware that for the past five years the Chicago Pneumatic Tool Company has owned and operated its own plant at Franklin, Pa., for the manufacture of these compressors. Although designed primarily for the operation of pneumatic tools, these compressors have found a wide demand throughout all compressed air uses, more than taxing the output of a large plant, the productive capacity of which has been repeatedly extended. So busy have they been in keeping pace with their market, that barring an occasional trade item, little has appeared in the technical press concerning the remarkable development of this industry, and the accompanying illustration and description of a Franklin Air Compressor is one of the first published.

This machine in general follows the most advanced practice, being the result of experience gathered from the most successful compressor builders, avoiding weak spots and following original lines on points vital to maximum efficiency. The compressor shown herewith is especially suited to the requirements of industrial works, mines, quarries, etc. It is of duplex pattern, with simple or cross compound steam cylinders and simple or two-stage air compressing cylinders, according to working conditions. A variety of combinations is obtainable for varying pressure conditions, and machines are also built for motor or water wheel drive, either direct or by belt, gear or chain. These compressors are built in sizes ranging in capacity from 30 to 2,000 cubic feet of free air per minute displacement for 10 to 125 pounds per square inch working air pressure and suited to all compressed air users. Frames are heavy box shaped castings, graceful in outline, strongly ribbed with large factor of safety to withstand strain when working at maximum load. The bottom surface bearing upon foundations throughout its entire length insures stiffness not only at the main bearing, but also along the guides at the connection with the cylinder. This construction affords an even distribution of strain upon the foundation and also of the internal stresses which the bed itself must sustain. Cross head guides are bored and provision is made for catching and draining drip from bearings and stuffing boxes. Being entirely self-contained expensive foundations are avoided and expert erection services unnecessary.

The cylinders are made from a mixture of special iron and selected scrap and are of sufficient strength and thickness to withstand the pressure for which they are designed after reboring. The steam cylinders have interior walls covered with asbestos or mineral wool and are neatly lagged with planished iron. The air cylinders and cylinder heads are completely water jacketed, providing a thorough circulation of water with equal cooling at all points. The pis-

tons are of solid type with cast iron spring rings, accurately fitted. The box cross head is provided with taper shoes, turned to fit the cylinder guides. These shoes have screw adjustments affording a ready means of taking up the slight wear and of securing proper alignment. Oil guards at each end of the lower slide on the bed give continuous lubrication to the lower shoe, while a sight feed oil cup on top of the bed provides the necessary oil for the upper shoe. The piston rod is screwed into the cross head and secured by a lock nut. The connecting rod is of substantial pattern with solid cross head and having wedge and adjustment screws. The crank end is of marine type, with heavy bolts and brass liners. The single compressor has two balance wheels, one on each side to insure smooth operation. Duplex and cross compound compressors have heavy fly wheels made in two sections, securely bolted to-




END VIEW TYPE OF G-D S C AIR COMPRESSOR. ILLUSTRATES MECHANICALLY MOVED INTAKE VALVES.

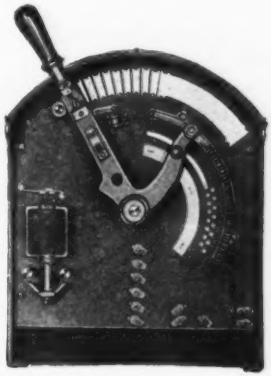
gether at the hub and at the rim. All bearings are of unusually liberal proportions and only the best materials are used in their construction, with the most improved provisions for adjustment, to eliminate all trouble from heating and to reduce wear in working parts to a minimum.

Steam driven compressors are provided with a pressure regulating governor to automatically control the operation of the compressor in accordance with the demand for air, working in connection with a speed governor which regulates the speed of the compressor. Single steam and belt driven compressors also have an unloading device to relieve the compressor of all load when the desired air pressure is obtained, and automatically cause it to resume delivery when the receiver pressure becomes reduced. Smaller steam driven compressors have plain "D" slide valves accurately scraped to seat and securely fastened to rod with adjustment for wear. Steam cylinders twelve inches in diameter or larger are provided with the Meyer adjustable cut-off valves, the main valve being balanced, thus reducing the liability of excessive wear and increasing the life of the valve and valve gear by relieving the strain upon all valve gear parts.

Franklin air compressors are especially designed for operating pneumatic chipping, caulking, riveting and stone cutting hammers, drills, reamers, sand rammers, wood boring machines, flue cutters, painting machines, straight lift and motor hoists, stone surfacing machines and all classes of compressed air equipment in machine shops, boiler shops, railroad shops, ship yards, stone yards and in bridge and building construction work; pumping natural or artificial gas, driving rock drills, coal cutters, pumps, locomotives, hoisting engines and other machinery in mines, tunnels and quarries; operating railway signals, testing and charging air brake equipments, sinking bridge caissons, displacing and agitating chemicals, pumping water by compressed air and for every other purpose for which compressed air is employed. Full information may be obtained from the manufacturers, the Chicago Pneumatic Tool Company, at its offices Chicago or New York, or any of its branches.

**New Controller.**

THE Cutler-Hammer Mfg. Co. of Milwaukee has recently placed on the market a new line of printing press and machine tool controllers. These controllers are of the well-known "Carpenter" type and embody the distinctive features of this class of Cutler-Hammer apparatus. The essential difference between the new controllers and the older type is that the former provide for a greater number of field speeds than the latter. At the time the first "Carpenter" printing press and machine tool controllers were placed on the market it was the accepted practice to obtain the major portion of speed variation by means of armature resistance, the

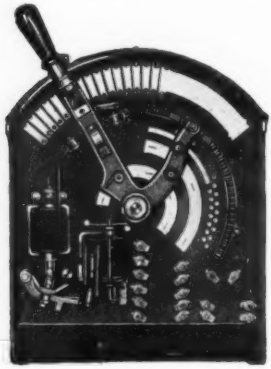


CUTLER-HAMMER NON-REVERSIBLE COMPOUND CONTROLLER FOR PRINTING-PRESSES AND MACHINE TOOLS. UNDERLOAD RELEASE ONLY. COVER REMOVED.

increase in speed secured by means of field control, seldom exceeding 15 per cent. Of late, however, variable speed motors, so designed as to permit of their speed being increased as much as 400 per cent. by field control have come into use and the present line of controllers has been designed to meet this new condition in printing press and machine tool work.

Like the older type of apparatus the new line of controllers is provided with an auxiliary breaking device equipped with a powerful magnetic blow-out. In opening the circuit by moving the lever to the "off" position the break does not occur on the

contacts, but on the auxiliary device located just below the contact segments. This prevents arcing on the contacts. The contact segments themselves are of hard-drawn copper and are separately renewable. The controllers are equipped with cast-iron covers which completely enclose all of the apparatus except the handle of the operating lever. The lever itself, instead of being cast in a straight bar, as in the older type of apparatus, is formed with a projecting arm carrying the contact shoe for the field speed points. This construction contributes to the compact arrangement of the controller. All contact parts are removable from the slate front without disturbing interior connection and all terminals are labeled with brass tags, insuring proper wiring. In this new line of controllers the speed regulation is effected by means of both armature and field resistance, the armature resistance being furnished separately, though it is possible to mount it with the front if desired. The field resistance is, in all cases, attached directly to the front of the controller and provision is made for holding the lever positively on any desired contact.



CUTLER-HAMMER REVERSIBLE COMPOUND CONTROLLER FOR PRINTING-PRESSES AND MACHINE TOOLS, WITH UNDERLOAD, OVERLOAD AND PUSH-BUTTON RELEASE AND DYNAMIC BRAKE. COVER REMOVED.

Six distinct pieces of apparatus are comprised in this latest line of printing press and machine tool controllers—three non-reversible and three reversible. In each class the controller may be had with underload release only; with underload and overload release, and with underload, overload and push-button release and dynamic brake. The new apparatus is described in Cutler-Hammer's bulletins which will be sent on request.

VIEW OF NEW CUTLER-HAMMER PRINTING-PRESS AND MACHINE TOOL CONTROLLER WITH COVER IN POSITION.

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### Double Crimped Wire Cloth.

THE Ludlow-Saylor Wire Co., St. Louis, are doubling the already large capacity of their plant for the manufacture of "Double Crimped" wire cloth, and especially for the style known by their trade name of "Perfect." Double crimping prevents the lodging of any rock splinters and the process is valuable for this reason, while the screening surface is fully twice as much as a perforated screen and the strain is more evenly distributed. Only the toughest wire is used, insuring long life, and this is especially true of the brass screens which are used wherever the water is acid. The mesh is accurate, giving, therefore, the best results.

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### Wing's Turbine Fan.

WING'S turbine fan is the combination of two machines, the Wing disc fan, and a well designed turbine engine. It is the invention of L. J. Wing,

President of the L. J. Wing Mfg. Co., who originally invented and patented the disc fan, of which there are many thousands in use in this and other countries. The L. J. Wing Mfg. Co. have been putting them on the market over a year, and have met with great success, finding unlimited demand for such a combination. The blades of the fan are practically the same as those used on the Wing disc fan when used for ventilation, run by belt, electric motor, or direct connected old type engine. The turbine engine consists of a series of well designed turbine buckets or vanes fastened to a band or ring which in turn is fastened to the end or periphery of the fan blades, as shown on the illustration. Two or more nozzles of special design impinge the steam into the buckets, and causes the fan to rotate. This gives an economical and positive power. The small amount of steam from the nozzles after exerting all its energy in driving the fan passes right along with the air and, therefore, no exhaust pipe is required. This fan can be used in places where no other type of fan and engine could be used to advantage. At the present time they are used largely for mechanical draft for boilers. When used for this purpose the fans are masoned into the side or rear wall of the boiler just below the grates.

Mechanical draft enables the burning of a cheap grade of fuel which cannot be burned with natural draft. Aside from that there are other advantages, such as saving in cost of fuel, adding to capacity of boilers by heating the tubes more evenly and full length, thus keeping the boilers in better condition, and that the steam from the fan helps to deteriorate the clinkers, and keeps the grates in better condition. Another advantage is that this system of mechanical draft is flexible, while a chimney is not. The fans can be moved or more fans can be added as the plant grows, whereas the chimney cannot be moved or enlarged. The fans are not affected by atmospheric conditions as a chimney is.

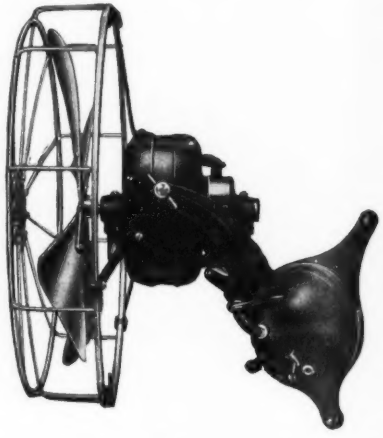
With a chimney draft it is necessary to clean the fire more often in order to keep up steam, whereas the chimney draft is constant, and is the same every day, and in case of sudden call for more steam, or bad coal the fans can be run at a higher speed, and the steam is kept up, while the chimney draft cannot be increased, and the steam drops and often make serious trouble and delays. The turbine fan be-

ing very simple and strong in its construction and having no wearing parts except the ball bearings requires no care or attention beyond putting some vaseline or other lubricant in the bearings once a month.

### Alternating Current Fan Motor.

AN alternating current fan motor is now being placed on the market by the Western Electric Company which bids fair to be a great success. Heretofore the principal method of operating fans by alternating current has been by what is called the induction motor. The induction motor, however, has always had one great drawback and that is its uncertainty in starting immediately when the current is turned on. The reason for this trouble has been due to the simple fact that while most of the lighting and power companies furnish alternating current, it is nearly all what is known as single phase, and the ordinary induction fan motor will not run properly until it gets up to the proper speed. The starting torque is so small that it requires several spasmodic revolutions of the armature before the steady speed is obtained. The Western Electric's new fan motor does entirely away with this trouble by using a specially constructed commutator. They guarantee this motor positively to start when the current is turned on, because it does not operate on the induction principle, but in the same way as the regular series direct current fan motor.

Another great advantage of this motor is its "Universal" feature which allows it to be used either as a desk or bracket fan, and the change from one to the other can be made in a minute. They call it the "Two-in-One" type because it really makes one type of fan serve two purposes. An ingenious diagonal joint in the standard makes this change possible and a glance at the illustrations will make this clear. All the working parts of the motor are completely enclosed so that it is impossible to clog up the machinery with dust or dirt. From a mechanical standpoint the blades are great savers of current, the angles at which they are built following along specially designed lines, thereby furnishing maximum breeze with minimum current consumption.



### Tests of Metal Windows.

ALL of the tests of fire retarding materials and devices that are referred to by those interested in the sale of such are conducted by the Underwriters' Laboratories (Inc.) at Chicago, where the National Board of Fire Underwriters maintains a most perfectly equipped plant for the practical and scientific determination of the value of structures submitted to them. For more than three years tests of metal windows have been held and cards

of approval covering an extremely small percentage of those tested have been issued. Without this approval State underwriters may refuse to accept at minimum rating metal windows that are offered them. It devolves upon the architect therefore to insure his client against the purchase of material that will prove of doubtful value. All windows made of metal are fireproof in the sense that they will not add fuel to a fire but, with a very few exceptions, they have been found of such faulty design, and in some cases inferior construction, that they failed utterly. The Laboratory test stimulates an actual fire continued for sixty minutes, readings of temperature that runs as high as 1,650°, and notes regarding the condition of the window being taken at intervals of five minutes. At the conclusion of the hour the front portion of the retort carrying the window, then a bright cherry red, is slid to one side and is played upon until cold by a standard fire hose stream at twenty feet distance. The window is afterwards cut up for examination and a record made of the method used in manufacture. All approved windows are inspected during process of manufacture and after completion by an engineer from the Laboratory and to all that meet with established standards for material, construction and workmanship is attached a brass tag, numbered and registered, as evidence of correct shop practice.

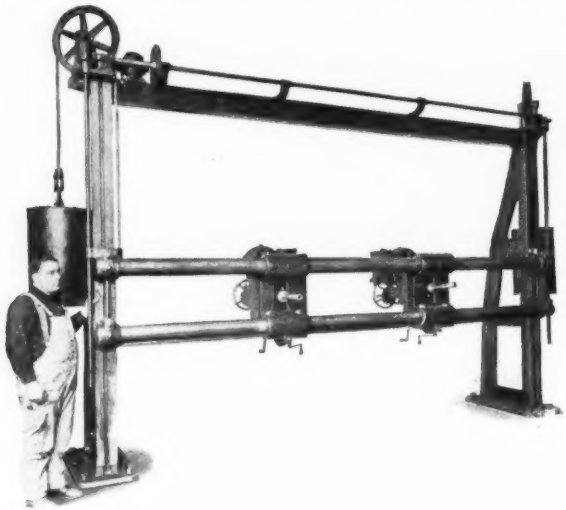
The windows made by Voigtmann & Company, Chicago, have been tested by the Laboratory and cards of approval issued by the National Board, and are made under direct supervision of the Laboratory's engineers. These windows are made in the only plant that is devoted exclusively to this one line, no cornices, skylights or other architectural sheet metal work being produced. Mechanics trained to produce one article must surely yield a result preferable to that possible if their effort is directed in various ways. Those interested in special or technical information concerning the manufacture and use of metal windows of stock design or special construction can secure, without charge, the services of a special department maintained by this firm.

**Motor-Driven Boiler Shell Drill.**

WE illustrate herewith a new boiler shell drill built by the Thos. H. Dallett Co., of Philadelphia, Pa. This machine is motor-driven throughout and has been designed for the special purpose of taking advantage of high speed steel, and as shown in the accompanying cut represents the latest development in machines of this character. As will be noted, there are two end housings, on the front face of which, carried by brackets, are two 5-inch bars on which are mounted two independent motor-driven drill-heads balanced by the counter-weights, having a vertical range of 6 feet and raised and lowered by means of screws actuated by a motor on the top rail of the machine, this motor being handled by a reversible regulator on the inside of the housing which does not appear in the cut. An especially noteworthy feature of this machine is the central position of the spindle, not only between the bearings of the drill-head on the bars, but also between the bars, so that the pressure of the drill against the work has no tendency to set up torsional or sidewise strains in the drill-head or bearings, causing excessive friction of the drill in the hole, rapid deterioration of the drill and undue consumption of power, owing to the spindle being thrown out of alignment, as must be the case where a drill spindle is not central of its supports. The machine is entirely self-contained, all adjustments being effected by means of crank handles and hand wheels, no wrenches whatever being required, and the operator has all the adjustments of the drill-head at his command from either side of the drill-head without moving from his position. In the lowest position of the carriage, the centre of the spindles are 21 inches from the floor, and in its highest position, 7 feet 6 inches. The distance between the housings is 14 feet and the distance between spindle centers when the drill-heads are in their outermost position is 12 feet. The length of the standard machine over all is 17 feet 8 inches, the height 11 feet 6 inches and the total weight 12,000 lbs.

As this cut shows, each drill-head has a vertical adjustment in itself of 6

inches, operated by a crank handle at the bottom, and is moved along the bars by means of a pinion and rack on the under side of the lower bar. The motors shown on these drill-heads are Northern 2-H.P. variable speed motors, the regulating box and switch being mounted on the opposite side of the motor. There are no bevel gears used in the transmission



from the motor shaft to the spindle, making a very durable and efficient gear reduction. The spindle speeds range from 80 r. p. m. to 160 r. p. m. and the whole mechanism of the drill-head is especially designed and built for the purpose of using high speed steel drills if desired. The spindle is 1-13/16 inches in diameter, is bored for a No. 4 Morse taper, has a traverse of 18 inches and a perpendicular range through an arc of 15° to permit drilling rivet holes radially to the center of the boiler, which is set on rollers in front of the machine. The last movement is controlled by the hand-wheel which appears immediately beneath the gear reduction.

The feeding mechanism consists of a feed-shaft, crank head, rocker pawl plate, pawl, ratchet wheel, feed nut and feed screw, the thrust of the latter being directly upon the back end of the spindle. The connecting rod between the crank and rocker plate is fitted with a spring which can be set for any pressure of feed, so that it is impossible for this pressure to be exceeded, as the spring is compressed when the limit is reached and the feed ceases to operate until the pressure is reduced, thus making an automatic relief. Change of feed is effected by shifting the thumb-latch around the crank head and a range of feeds from .005 inch per revolution of spindle to 1/16 inch can be obtained. This range of feed covers the entire requirements of drilling in boiler work.

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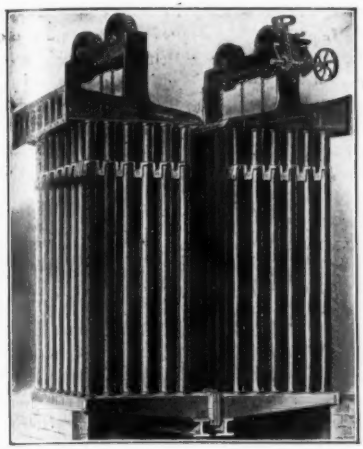
### Saving Coal in Making Water Gas.

SO much heat is carried away in the blow-up gases in making water gas that about 40 to 48 lbs. of anthracite or coke are required for the generator per thousand cubic feet of gas produced. Yet, only about half the B. T. U. contained in the coal are available in the gas; that is, the efficiency of the process is usually less than 50 per cent. We illustrate an arrangement adapted by the Newburgh Gas Light Company, of Newburgh, N. Y., which saves one-half of the waste and thus requires one-quarter less coal than the ordinary process. The plant consists of a generator 6′ x 14′, a carbureter in which the oil is added, of the same size, and a super-

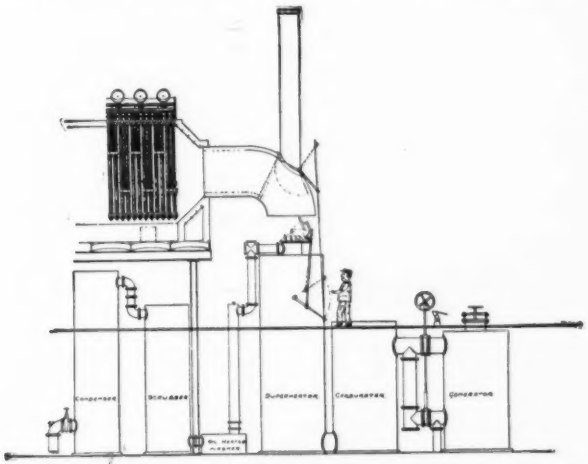
heater 6′ x 22′. Formerly, after the blow-up gases from the generator passed



GREEN AIR HEATER OF 96 TUBES BEFORE ENCLOSURE.

through the carbureter and superheater, they were allowed to waste to atmosphere. The saving has been accomplished by the recent addition of a Green air heater encased in a brick chamber above the charging floor and provided on one side with a sheet iron funnel which opens over the superheater escape valve. In this funnel there is an opening to a short stack with a damper, so that upon occasions, as when the air heater is being cleaned, the blow-up gases can be allowed to escape directly to the atmosphere as formerly. When this damper is closed, however, the gases pass into the chamber among the tubes of the heater and then to a stack on the farther side of the heater, through which they escape to the atmosphere. This stack also has a damper to control the draft. As the gases escape from the superheater into the hood they ignite, the carbon monoxide (CO) burning to carbon dioxide ($CO_2$) and liberating about 1,000 B. T. U. per pound of carbon monoxide thus burnt. By regulating the damper in the air heater stack the amount of air drawn into the hood with the gas may be so closely regulated that there is perfect combustion without the admission of excess cold air.

The Green air heater consists of a group of vertical cast iron tubes forced by hydraulic pressure into top and bottom boxes to form 4 or 8 tube units as shown in the accompanying photograph of an 86-tube



HOW THE GREEN AIR HEATER OR THE GREEN FUEL ECONOMIZER, OR BOTH, ARE USED TO RECOVER WASTE HEAT FROM THE STACK-VALVE GASES.

heater. After it is set up the blow-up gases from the hood pass in among the tubes, while at the same time the air supply for the generator is forced through the tubes by a blower and takes up heat from

the gases returning it to the generator. The result is that it is not necessary to blow the generator so long to bring it up to the required temperature and not so much fuel is required in the blowing-up process, with a resulting saving in the present case of about one-fifth of the fuel required for the generators. The outsides of the tubes are kept clean of soot by automatic scrapers which travel slowly up and down. The heater at Newburgh was installed in November, 1905, and a careful record kept of the cost. The results show a saving not only of coal, but also of the oil used in the carbureter, due probably to the higher average temperature at which the apparatus was operating. The stack valve gases which originally left at from 1,500 to 1,800° F., now leave at about 800° F., all the difference being absorbed in useful work. The Green Fuel Economizer Company of Matteawan, N. Y., have just issued a booklet containing complete tests and figures on the making of water gas and will send it free to anyone who writes.

# NEWS SUPPLEMENT

The Engineering Magazine—June, 1907

### Personal.

—A. Samuel Berquist, manufacturer of Berquist's suspension bunkers, will visit Europe on a business and pleasure trip in June.

—Charles H. Glasser, formerly mechanical engineer of the Camel Co., Chicago, has accepted a position with the American Steam Gauge & Valve Mfg. Co., and will make his headquarters at their Chicago office.

—E. P. Leadbetter has been appointed manager of the Pittsburg office of the Buffalo Forge Co. For the past three years Mr. Leadbetter has been connected with the Philadelphia office of the Buffalo Forge Co. and previous to that time at their factory office in Buffalo.

—Dr. F. P. Van Denbergh, for the past year chief chemist to the Belen Mines, Sonora, has recovered his health while in Mexico and returned to the United States and will settle at Santa Rosa, Leonard Wood County, New Mexico, to develop personal interests in New Mexico.

—The Under-Feed Stoker Co. of America, manufacturers of the Jones stoker, Marquette Building, Chicago, announces the appointment of Paul M. Chamberlain, M. E., as chief engineer. Mr. Chamberlain was graduated in engineering at the Michigan Agricultural College in 1888 and at Cornell University in 1890. After several years spent in practical work with the Brown Hoisting & Conveying Machinery Company of Cleveland; Frick Company, engineers, of Waynesboro, Pa., and the Hercules Iron Works of Aurora, Ill., he accepted the assistant professorship of mechanical engineering at the Michigan Agricultural College.

### Industrial Notes.

—American Gas Furnace Co. are now located at 24 John St., New York.

—Robb-Mumford Boiler Co. have moved their New York offices to the West Street Building, 90 West St.

—The Chicago office of the Norton Company and the Norton Grinding Co. is now located at 48 So. Canal St.

—Albany Steam Trap Co., manufacturers of steam traps, announce that they have removed their plant to No. Pearl Street, Albany.

—Northampton Portland Cement Co. announce that their sales office is now located at the general office and mill, Stockertown, Pa.

—Hudson Engineering & Contracting Co. announce that they have moved their offices to the West Street Building, 90 West St., New York.

—The Mississippi Glass Co. has purchased the Sergeant Glass Co.'s plant at Kane, Pa., and will operate it in manufacturing rolled, figured, polished plate and fire glass.

—Pittsburg Foundrymen's Association are to be guests of The S. Obermayer Co. in June. A special train will take them on a tour of inspection to The S. Obermayer Co.'s new plant at Rillton, Pa.

—The Norton Grinding Co., Worcester, manufacturers of cylindrical grinding machinery, bench and floor grinding machinery, are erecting a building which will double their present capacity.

—Sturtevant dry kiln apparatus is being installed in connection with lumber dry kilns for Theodore Kuntz, Cleveland, Ohio; E. S. Adkins & Co., Salisbury, Md.; and Bennett Lumber & Mfg. Co., Bennett Station, Pa.

—A. D. Granger Co. announce the change in its New York office to the West Street Building, 90 West Street, where they have much larger and more commodious offices arranged for the better conduct of their business.

—The New York office of the B. F. Sturtevant Company has just been removed from 131 Liberty Street to the Engineering Building at 114 Liberty Street, where much better facilities will be provided for conducting the increasing business of this company.

—The American Locomotive Co., Schenectady, N. Y., is installing an electrically-driven Sturtevant fan to remove smoke from the new running shed. This is practically a duplicate of one previously furnished by the B. F. Sturtevant Co., Boston.

—The Western Electric Co., Chicago, are about to issue their 1907 edition of their supply catalogue. This will be a large volume of 700 pages, and will list everything of any importance in the electrical line. The edition for this year will be much more complete and instructive, however, than any which has heretofore been published by this company.

—The Epping-Carpenter Co., manufacturers of pumping machinery, Pittsburgh, Pa., have made a change in their New York representation, Chas. T. Henry Company, of 141 Broadway, being no longer their agent, they (Epping-Carpenter Co.) having opened an office at 90 West Street, in the new West Street Building; the office is in charge of Messrs. F. B. Slocum and George B. Ferrier, Jr.

—Among recent sales of generating sets made by the B. F. Sturtevant Co., Boston, are the following: Isador Fajans, New York; Augusta Lumber Co., Augusta, Me.; Norfolk & Washington Steamboat Co., Newport News, Va.; North Packing & Provision Co., Somerville, Mass.; Fisheries Co., Philadelphia, Pa.; Lincoln Mfg. Co., Fall River; and Hudson Companies, New York.

—The Norton Company, Worcester and Niagara Falls, manufacturers of grinding wheels made of alundum and other abrasive specialties, is to erect a large addition to its Worcester works. They will extend the building designated as Plant 2 about 200 ft. in length by 111 ft. in width, which will more than double the present capacity. This will be fully equipped with kilns, mixing machines, shaving machines, etc., so as to permit of a large increase in output.

—J. H. Wagenhorst & Co., Youngstown, O., manufacturers of the Wagenhorst electric blue printing machines, announce a partial list of recent sales as follows: S. M. Greene, Holyoke, Mass.; Monongahela River Cons. Coal & Coke Co., Pittsburgh; George S. Mills, Toledo, O.; Eugene Dietzgen Co., New York; Babcock & Wilcox, Barberton, O.; J. W. Gaddis, Vincennes, Ind.; Multi-Color Copying Co., Detroit; American Steel & Wire Co., Joliet, Ill.; Thomson Stationery Co., Vancouver B. C.

—The largest order for steel rails ever placed with a single concern was made public May 11. This was the order for 150,000 tons of steel rails placed by the Harriman lines with the Tennessee Coal and Iron Co. for delivery after March, 1908. In order to handle its greatly increased business the Tennessee Coal & Iron Co. has just placed an order with the Crocker-Wheeler Co., Ampere, N. J., for the complete electric motor equipment of its new steel rail mill at Birmingham, Ala.

—Among the many sales closed last month by the Under-Feed Stoker Co. of America, Marquette Building, Chicago, occurs an order for the installation of twenty stokers in two separate plants of the Dixie Portland Cement Co., Copenhagen, Tenn., each plant consisting of 5 400 H.P. Heine boilers. The Georgia Railway & Electric Company also has placed an order for Jones stoker equipment. When installed

this will make a total of thirty-six Jones stokers in their Butler St. Station, equipping 7,200 H.P. of B. & W. boilers.

—The Abner Doble Co., engineers of San Francisco, have appointed Mitsui & Co. to act as their sole agents in Japan and its territories, Korea, China and Manchuria, for the sale of Doble tangential water wheels and hydraulic apparatus. The industrial development that is now taking place in the Orient, and the increasing demand for high grade water wheel machinery will make this co-operative arrangement an advantageous one for both parties. Mitsui & Co. is one of the largest and most progressive engineering houses in the Far East.

—The Trustees of the Rensselaer Polytechnic Institute have decided to establish courses in mechanical and electrical engineering. The recent gift of one million dollars from Mrs. Sage and other recent gifts through which they have been able to increase the value of their plant for the purposes of instruction, enables them to do this. These courses will be very general engineering courses. In this respect they will be similar to the civil engineering courses now given at the Institute which has always been very general in its character.

—The Lunkenheimer Co., Cincinnati, has established its Eastern office and warehouse in much more commodious quarters, in the building at 66-68 Fulton Street, New York, recently erected; Alfred J. Jupp managing this division of the company's business. In making provision for an adequate stock from which to supply the Eastern and Atlantic Coast trade easily and quickly, it was necessary to use to the best advantage the space occupied, and by somewhat unique methods prepare for the accommodation of a large assortment as well as sufficient quantities, so arranging the irregular floor space as to have it attractive in appearance.

—The dynamo-dynamometers for testing automobile engines, which have been supplied by Joseph Tracy to a number of the leading automobile builders, will in future be marketed by the Sprague Electric Co. under an arrangement by which Mr. Tracy will supervise the construction of the apparatus, which will be manufactured at the Sprague Electric Company's works. The increasing use of this accurate means of determining the horse power of gasoline engines is in line with the growing movement toward standardization and correct power ratings. The method has been used for a number of years abroad by the Panhard concern and other notable builders, and is now being taken up quite extensively by American manufacturers.

—The Illinois Central R. R. Co. have just placed with Wm. B. Scaife & Sons Co., Pittsburgh, the eighth and ninth contracts for We-Fu-Go water softening and purifying systems, comprising a 300,000 gallon per day plant for Manchester, Iowa, and a 400,000 gallon per day plant for Waterloo, Iowa. Among some of the recent orders placed for We-Fu-Go and Scaife water softening and purifying systems are the American Steel & Wire Co., Donora, Pa., 12,500 H.P. We-Fu-Go system; American Sheet & Tin Plate Co., Cambridge, Ohio, 1,000 H.P. We-Fu-Go system; The Woodward Iron Co., Woodward, Ala., a 10,800 H.P. We-Fu-Go system; for the Minneapolis, St. Paul & Sault Ste. Marie R. R. Co. a 250,000 gallon per day We-Fu-Go continuous system; for the Coshocton Straw Paper Co. a 500 H.P. Scaife system.

—Locke Regulator Co., Salem Mass., announce the following list of recent sales: Chas. Scribners' Sons Co., New York, 6 stops; Stearns & Foster Co., Lockland, Ohio, 1 stop; Ball & Wood Co., Elizabethport, N. J., 1 stop; Otsego Paper Co., Otsego, Mich., 1 stop; La Crosse Rubber Co., La Crosse, Wis., 1 stop; Fuller & Johnson Mfg. Co., Madison, Wis., 1 stop; Gisholt Machine Co., Madison, Wis., 3 stops; American Steel & Wire Co., Allentown, Pa., 1 stop; Minneapolis Steel & Machinery Co., Minneapolis, 1 stop; Chicago-Kenosha Hosiery Co., Kenosha, Wis., 1 stop; Vincennes Electric Light Dep't., Vincennes, Ind., 1 stop; Ryegate Paper Co., East Ryegate, Vt., 1 stop; Chattanooga Plow Co., Chattanooga, 1 stop; T. M. Sinclair & Co., Cedar Rapids, Mich., 1 stop; Morgan Engineering Co., Alliance, Ohio, 1 stop; Simmons Mfg. Co., Kenosha, Wis., 1 stop; International Paper Co., Fall

Mountain Mill, Bellows Falls, Vt., 2 stops; Colin Gardner Paper Co., Middletown, Ohio, 2 stops.

—The Heine Safety Boiler Co., St. Louis, reports some recent sales as follows: Asano Cement Co., Tokio, Japan, 4 boilers aggregating 900 H.P.; Atlantic, Gulf & Pacific Co., 4 200 H.P. boilers; American La France Fire Engine Co., Elmira, 2 230 H.P. boilers; American Locomotive Works, Richmond, 4 400 H.P. boilers; Bridgeport Forge Co., Bridgeport, 3 250 H.P. boilers; Crown Cotton Mills, Dalton, Ga., 2 400 H.P. boilers; Home Brewery, Columbus, 3 200 H.P. boilers; Hudson Companies 2 316 H.P. boilers; Independence Kansas Cement Co., Independence, Kas., 3 400 H.P. boilers; James S. Kirk & Co., Chicago, 2 500 H.P. boilers; Jos. J. Little Building, New York, 3 275 H.P. boilers; Quincy Horse R'y & Carrying Co., Quincy, Ill., 3 316 H.P. boilers; City of New York for Ridgewood Pumping Station, 8 300 H.P. boilers; Pueblo & Suburban Traction & Lighting Co., Pueblo, 1 378 H. P. boiler; Denver Gas & Electric Co., Denver, 3 524 H.P. boilers; Texas Co., Beaumont, 32 200 H.P. boilers for 8 pipe line oil pumping stations in Texas; Victor Talking Machine, Camden, 2 316 and 2 270 H.P. boilers; Warren Mfg. Co., Warren, R. I., 1 323 H.P. boiler, making a total of 2,881 H.P. on six orders; Willamette Pulp & Paper Co., Oregon City, Oregon, 1 250 H.P. and 2 366 H.P. boilers; U. S. Navy Department for Norfolk Navy Yard, 2 428 H.P. boilers and 4 350 H.P. boilers; U. S. Navy Department for Charlestown Navy Yard through Muralt & Co., New York, 4 350 H.P. boilers, and Philadelphia House of Refuge, Glen Mills, Pa., 4 250 H.P. boilers.

## NEW CATALOGUES AND TRADE PUBLICATIONS

*These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.*

**Air Compressors.**

SULLIVAN MACHINERY CO., Chicago.—"Modern Practice in Air Compression" is the title of catalogue No. 58 treating of air compressors. Well printed and finely illustrated. 6 by 9 in.; pp. 112.

**Air Compressor Outfits.**

ABENAQUE MACHINE WORKS, Westminster Station, Vt.—Bulletin illustrating and describing gas and gasoline driven direct connected air compressor outfits. 6 by 9 in.; pp. 8.

**Blocks.**

LANE BROS. CO., Poughkeepsie, N. Y.—Catalogue containing an illustrated description of automatic tackle blocks, with prices and sizes. 6 by 9 in.; pp. 32.

**Boilers.**

ROBB ENGINEERING CO., LTD., Amherst, N. S., Canada.—Catalogue illustrating and describing Robb-Mumford boilers, tubular boilers, vertical boilers and marine boilers. 6 by 9 in.; pp. 50.

LYON BROTHERS CO., Chicago.—Booklet containing a brief illustrated description of the Bonson boiler, which is a combination of the tubular and water tube types. 4 by 9 in.; pp. 16.

**Buildings and Bridges.**

BERLIN CONSTRUCTION CO., Berlin, Conn.—Well printed catalogue illustrating and describing some of the recent buildings and bridges erected by this Company. 8 by 5½ in.; pp. 80.

**Coal Handling Machinery.**

C. W. HUNT CO., West New Brighton, N. Y.—Catalogue No. 072 illustrating and describing coal handling machinery for power stations, boiler rooms, coaling stations, etc. 6 by 9 in.; pp. 62.

**Dies and Taps.**

WILEY & RUSSELL MFG. CO., Greenfield, Mass.—Catalogue, pocket size, illustrating and describing screw cutting and other labor-saving machinery and tools. 3½ by 5½ in.; pp. 224.

**Drawing Tables.**

R. E. KIDDER, Worcester.—Booklet containing an illustrated description of many different styles of drawing tables with prices and dimensions. 4½ by 7 in.; pp. 10.

**Fans.**

GARDEN CITY FAN CO., Chicago.—Catalogue No. 24 illustrates and describes fans, exhausters, blowers, etc., together with tables giving sizes, prices, etc. 9 by 6 in.; pp. 126.

**Fan Motors.**

WESTERN ELECTRIC CO., Chicago.—Bulletin No. 4007 illustrating and describing the 1907 model fan motors, together with tables giving code word, list number, voltage, approximate amperage and list price. 6 by 9 in.; pp. 44.

**Feed-Water Purifiers.**

F. E. KEYES & SON, New York.—Leaflet illustrating and describing feed water purifiers. Also gives sizes and prices, together with a partial list of users. 4½ by 7½ in.; pp. 4. Also a pamphlet illustrating and describing the Advance boiler feed and purifier. 4½ by 7½ in.; pp. 4.

**Feed-Water Haters and Purifiers.**

HOPPES MFG. CO., Springfield, O.—Catalogue illustrating and describing live steam feed-water purifiers, exhaust steam feed-water heaters and purifiers, steam separators, oil eliminators and exhaust heads. 6 by 9 in.; pp. 40.

**Gas Engines.**

MILLER IMPROVED GAS ENGINE CO., Springfield, O.—Catalogue illustrating and describing gas engines. Also contains a list giving sizes. 6 by 9 in.; pp. 12.

C. H. A. DISSENGER & BRO., Wrightsville, Pa. Catalogue illustrating and describing stationary, portable and traction gas and gasoline engines. 10 by 7 in.; pp. 44.

CARLIN MACHINERY & SUPPLY CO., Allegheny. —Bulletin No. 16, illustrates and describes gas and gasoline engines. 6 by 9 in.; pp. 4. Bulletin No. 20 treats of gas driven air compressors. 6 by 9 in.; pp. 4.

**Gas Producers.**

BACKUS WATER MOTOR CO., Newark.—Catalogue illustrating and describing suction gas producers and gas engines. 9 by 6 in.; pp. 16.

**Gauges.**

ASHCROFT MANUFACTURING CO., New York.—Well printed catalogue illustrating and describing steam pressure and vacuum gauges, Edson recording gauge, Tabor steam engine indicator and a general line of engineering instruments, together with prices. Bound in cloth. 6 by 9 in.; pp. 136.

**Graphite.**

JOSEPH DIXON CRUCIBLE CO., Jersey City.—"A Study in Graphite" is the title of a booklet giving in detail a series of tests of graphite made by Prof. W. F. M. Goss of Purdue University. 6 by 9 in.; pp. 44.

**Grinding Machines.**

ROTH BROS. & CO., Chicago.—Bulletin No. 156 illustrates and describes electric motor grinding and polishing machines. 6 by 9 in.; pp. 8.

**Emery Wheels.**

SPRINGFIELD MFG. CO., Bridgeport.—Catalogue illustrating and describing emery wheels and grinding machinery. 66½ by 9½ in.; pp. 102.

**Jacks.**

JOYCE, CRIDLAND CO., Dayton.—Leaflet illustrating and describing lifting jacks for stone yards and quarries. Also gives sizes, prices, etc. 4 by 9 in.; pp. 8. Also a folder descriptive of a new jack designed especially for railway use. 4 by 9 in.; pp. 8.

**Japanning Ovens.**

E. E. STEINER, Newark.—Leaflet illustrating and describing ovens particularly adapted for baking, drying, laquering, core drying, etc., together with a partial list of users. 4¼ by 7 in.; pp. 8.

**Lubricators.**

GREENE, TWEED & CO., New York.—Catalogue illustrating and describing the latest improved Rochester automatic lubricators and their mode of application to some of the many types of engines, pumps, machines, elevators, etc., to which they are adapted. 6 by 9 in.; pp. 72.

**Mine Locomotives.**

JEFFREY MFG. CO., Columbus.—Bulletin No. 12 treats of the care of electric mine locomotives in service. The bulletin is well printed and contains many illustrations. 8 by 10 in.; pp. 80.

**Pipe.**

ABENDROTH & ROOT MFG. CO., Newburgh, N. Y.—Handbook No. 39 contains a price list, with illustrations, of spiral riveted pipe, water tube boilers, hydraulic mining supplies, etc. 4½ by 7¼ in.; pp. 128.

**Pipe Threading Machines.**

TOLEDO PIPE THREADING MACHINE CO., Toledo. —Illustrated catalogue briefly describing pipe threading machines. 7 by 5 in.; pp. 20.

**Propeller Fans.**

B. F. STURTEVANT CO., Boston.—Bulletin No. 146 illustrates and describes electric propeller fans. The fans are built in sizes ranging from 18 inches to 120 inches. 6½ by 9 in.; pp. 8.

**Pumping Machinery.**

UNITED IRON WORKS, Oakland, Cal.—Folder No. 25 treats of pumps for irrigation, reclamation and general pumping service. 6 by 9 in.; pp. 12. Folder No. 27 is devoted to an illustrated description of automatic excavators. 6 by 9 in.; pp. 12.

**Rails.**

WILLIAM WHARTON, JR., & CO., Philadelphia. —Cloth bound catalogue, fully indexed, illustrating and describing rails and special track work. 11 by 8½ in.; pp. 180.

**Regulators.**

LOCKE REGULATOR CO., Salem, Mass.—Booklet containing an illustrated description of pressure regulators. Valves, tumbling barrels, engine-stops and safety devices are also treated. 6½ by 3¼ in.; pp. 24.

**Reinforced Concrete Construction.**

L. J. MENSCH, Chicago.—Illustrated pamphlet showing some buildlings recently constructed of reinforced concrete. 9 by 12 in.; pp. 32.

ABERTHAW CONSTRUCTION CO., Boston.—Catalogue describing reinforced concrete as used in manufacturing plants. Illustrated with many views showing buildings, dams, etc., constructed by this Company. 6 by 9 in.; pp. 32.

**Rock Drill.**

INGERSOLL-RAND CO., New York.—Booklet 20A illustrates and describes the new Temple-Ingersoll electric-air rock drill. 5½ by 3¼ in.; pp. 13.

**Separators.**

POTTER SEPARATOR CO., Newburgh, N. Y.—Catalogue illustrating and describing mesh separators and superheaters. Also contains numerous testimonial letters and a partial list of users. 6 by 9 in.; pp. 16.

**Steam Pumps.**

EMERSON STEAM PUMP CO., Alexandria, Va.— Pamphlet containing testimonial letters from recent users of their steam pumps, quick cleaning strainers and foot valves. 6 by 9 in.; pp. 16.

**Valves.**

CRANE CO., Chicago.—Booklet illustrating and describing valves, fittings and appliances for

every purpose and all purposes. 4 by 6½ in.; pp. 96.

**Water Wheels.**

OAKLAND IRON WORKS, Oakland, Cal.—Illustrated catalogue describing water-wheels, together with many tables containing much valuable data. 4½ by 6½ in.; pp. 144.

**Wire Cloth.**

LUDLOW-SAYLOR WIRE CO., St. Louis.—Catalogue No. 31 containing a complete list of the various grades of wire cloth manufactured by this Company, together with price list and standard gauges. Illustrated. 6 by 9 in.; pp. 68.

**Wire Rope.**

MACOMBER & WHYTE ROPE CO., Chicago.—Catalogue containing a brief description of the different styles of wire rope, together with prices. 3¼ by 5½ in.; pp. 72.

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OLIVER MACHINERY CO., Grand Rapids.—Catalogue B illustrating and describing woodworking machinery and mill supplies. 6 by 9 in.; pp. 300.

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# IMPROVED MACHINERY

## New Processes and Appliances

*The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.*

### Sheet Steel Piling.

THE Watab Pulp and Paper Company and the Watab Rapids Power Company have recently completed a huge power plant, together with what is considered to be one of the most complete pulp and paper mills in the world, on the Mississippi river at Sartell, Minn. The plant is driven entirely by hydraulic power developed by a dam across the river at the site. The construction of the buildings, forebay, canal, flumes, tail-race, etc., involved no unusual difficulties, but the construction of the main dam was a hazardous undertaking. This dam is a rock-filled timber-crib structure with reinforced concrete abutments at each end. The original bed of the river, which was 600 ft. wide at the site before construction was started, consists of a hard clay soil with a layer of gravel, and in the river at the site of the dam there was a series of rapids over which the water flowed with considerable force even during low stages in the river; while during the flood periods the current was exceedingly swift and violent. At this site also the river has a maximum depth of 30 ft. during normal stages, which added greatly to the difficulties of the construction of the dam. A section of the dam was first built in the water over the desired location and was lowered with rock to sink and anchor it, heavy steel cables being used to prevent it from drifting away. This section was built from the opposite shore to midstream and of a height which permitted the water to flow over it until the construction of

that part of the dam adjoining the power house was well under way; but at the midstream end the height was about seven feet above water level, so as to provide for a suitable connection with a cofferdam necessary to be used in the construction of the power house section, which embraced the flood gates and log sluice.

Various methods were considered for controlling the waters to facilitate the construction of the power house section of the dam, but only two were deemed feasible for the accomplishment of satisfactory re-

sults. One method contemplated the building of cofferdams of rock and puddle filled timber cribs; the other involved the use of steel sheet piling. On account of adverse results in the prior use of interlocking steel piling in the vicinity of Sartell, as well as of the fear that the steel piling could not be driven into the hard clay soil and gravel, or, if so driven it was certain to be practically impossible to withdraw, it was concluded to employ the timber-crib construction; and accordingly two timber-cribs were built for cofferdams intended to lay bare about half the width of the river bed next to the power house. One of these cribs was built on the up-stream side and the other on the down-stream side of the crib of the main dam connecting with the latter at the stream end and with the river bank at the other end. The crib on the up-stream side was rock-filled and was built parallel with the crib of the main dam 50 ft. from the latter, and joined the main dam 200 ft. off shore. This crib was protected from the rapid current of the river by an additional rock filled timber crib built 25 ft. up stream from it in order to make possible a water-tight construction, this crib acting as a break-water. The crib on the down-stream side was earth-filled, and was also built parallel with the crib of the main dam and 50 ft. from it, so that these up-stream and down-stream cribs formed a cofferdam 150 ft. wide and 200 ft. long. The down-stream crib did not require to be carried to as great a height as the one on the up-stream side, owing to the difference in the water levels above and below the crib of the main dam. During construction the stream was gradually diverted around the end of the cofferdam described and over that part of the crib for the main dam which was not enclosed by the cofferdam, thus raising the head against the cofferdam and greatly increasing the current. After the up-stream crib of the cofferdam had been completed it was pushed somewhat out of line by the current and rendered useless as a water-tight structure. This necessitated the building of another rock and puddle filled timber crib within the space enclosed by the first one, but all attempts to seal even this auxiliary cofferdam with clay and puddle were unsuccessful, the current being so strong as to carry away the materials as fast as they could be placed and undermining both cribs. It was then concluded to employ United States steel sheet piling to seal the up-stream cribs of the cofferdam. The piling was driven between the two cribs on the out-stream side, as there was a distance of seven feet between them at this place, because the rock from the outer crib having lodged there when it failed, and through some of which the piling had to be driven in order to have a footing in the river bed to insure water-tightness. On the up-stream side, however, the piling was driven at the up-stream side of the outer crib, getting the full benefit of the swift current. The water was 25 to 30 ft. deep for a width of 140 ft. at the end of the cofferdam on the shore side, and across this deep place 30 ft. lengths of piling were first driven and followed by driving on top of them 10 ft. lengths in order to secure sufficient penetration in the clay bottom of the river to insure against any possibility of undermining. The alternate piles along the side of the cofferdam were driven 18 in. to 2 ft. deeper to break joints in that manner between the 30 ft. and 10 ft. lengths. After more shallow water was reached 30 ft. lengths only were used and were driven to a penetration of from 15 to 20 ft. The steel piling was driven at the rate of about 30 piles per day with a 10-h.p. hoisting engine and an ordinary drop hammer in connection with the usual pile driver for the driving of wooden piling.

After the steel piles had been driven the seepage was cut off entirely and there was no further trouble from undermining. A considerable quantity of water, however, came through the crib of the main dam, but the water level in the cofferdam was kept down by using one 8 in. and three 10 in. centrifugal pumps. While the water level was lowered the crib of the main dam and the sluice ways and log sluice were constructed and the steel piling afterwards withdrawn. The steel piling had produced such immediate results that it was decided to face the main dam for its entire length with steel piling, for the purpose of cutting off all seepage and thus insure the stability of the entire structure, as well to maintain the maximum efficiency of the dam. Steel piling was also driven in front of a con-

crete break-water built to protect the bluff of the river, for 100 ft. down stream. This piling was for the purpose of preventing the undermining of the break-water by the scour or tow created by the rapid water in the tail race, and likewise insuring the foundation of the mill building.

The work of pulling the piles in the cofferdam was done in February under as unfavorable conditions as could be imagined. The temperature was as much as 45° below zero Fahrenheit when the work of pulling was commenced. The puddle rock and clay on the bank through which the piles were driven, and the water in the river had been exposed from the inside of the cofferdam and were frozen to a depth of 10 to 12 ft. As the whole cofferdam, the river bank and the crib of the main dam were frozen, the use of dynamite to loosen the piles might have injured the mill building. A steam jet was therefore arranged to thaw the earth around the piles before pulling them. A pipe line was laid from the boiler house to the point of operations and supplied live steam to this jet. Two 18 in. triple blocks with a wire cable in connection with the equipment for driving were used and the pulling of piling progressed at the rate of 18 to 20 pieces each day.

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### Cranes for Panama.

THE accompanying illustration shows one of a lot of eight cranes now under construction by Shaw Electric Crane Co. of Muskegon, Mich., for the Panama Railroad Co. They are for use in handling miscellaneous freight at the Laboca wharf, which is the Pacific terminus of the railroad. The cranes were designed to meet the peculiar conditions existing at the wharf, among which is a tidal variation of about 20 feet. The boom, which is 80 feet in length, is shown in one view in its working position, standing at an angle a little over 30° from horizontal. It is required that the outer end should stand at sufficient height to carry loads over the decks of the largest vessels at high tide, while the other end must be low enough to project inside of the warehouse door. The boom may be raised to the position shown in the other view, carrying the outer end clear of all parts of vessels and withdrawing the inner end from the warehouse. With it in this position, vessels may be docked and the cranes placed opposite the various hatchways in proper position for loading or discharging cargoes.

The main frame or tower is of steel construction, and stands 62 feet above the track. There is a clear opening through it 10 feet wide, in which the boom is suspended and through which the loads are carried. The base is so constructed that

the crane can travel over freight piled to a height of 6 feet between the tracks, and so that goods may be trucked directly from under the crane to the warehouse. The space between the front of the warehouse and the edge of the wharf was sufficient for a track of only 11 feet gauge. This, together with the necessary height and reach, made the question of stability a serious one. Although the weight of frame and machinery has been so disposed that the crane will be stable with a load 25 per cent. above normal capacity in the extreme position, clamps have been provided which

are always in engagement with the rear rail, to prevent the crane from tipping if a load should become fouled on a hatchway or other part of the vessel.

The crane is mounted on six wheels, four under the front and two under the rear. Anticipating the possibility of uneven settling of the wooden wharf, the wheels are carried in equalizers, so arranged as to compensate for any probable irregularities of track without straining the structure. The machinery for the various movements is placed in the base of the tower, adding to the stability of the crane and giving easy access for inspection. For convenience in shipping and erecting, each set of machinery is mounted upon a separate frame, which is easily handled and put in place. The crane has a regular working capacity of four tons, and a reach of 40 feet from the center line between rails to the extreme outer position of load. The total height of hoist is 70 feet, and the speed, hoisting with full load, is 150 feet per minute. The load can also be racked out and up at a speed of 150 feet per minute. The other two movements, travel and boom hoist, are relatively slow, being required only in setting the crane in position for service. The hoist is operated by a 65 H.P. motor, the rack motion by a 40 H.P. and the travel and boom hoist by 24 H.P. and 8 H.P. motors respectively. Automatic switches are provided to prevent overtravel in hoisting and racking out, also an overload switch for the hoist machinery. All movements are under the control of one operator, whose cab is located as to give him the best view of his work.

The crane weighs nearly 50 tons, and with the boom in the raised position it stands 90 feet above the wharf. The motors and controllers, as well as all structural work and machinery, are the product of The Shaw Electric Co.'s plant at Muskegon.

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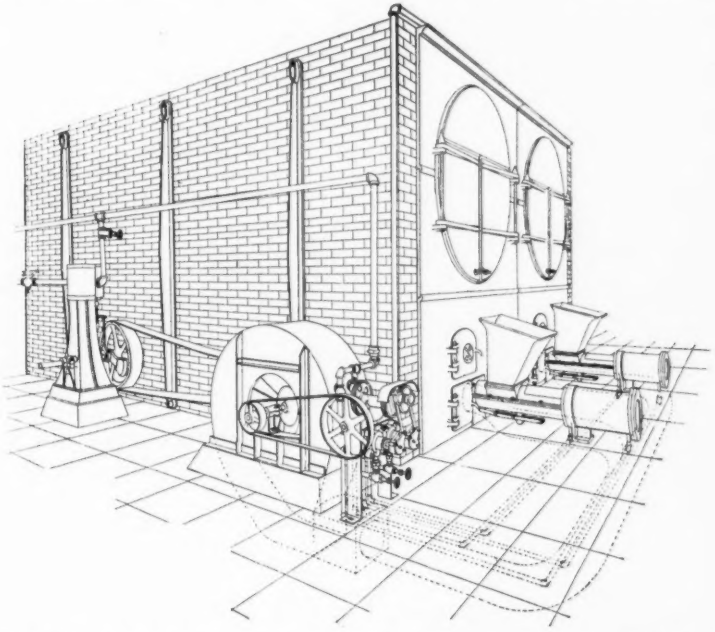
**The Lane "Junior" Tackle Block.**

THE accompanying cut represents a new block which Lane Bros. Co., Poughkeepsie, N. Y., have designed and placed on the market to supply the increasing demand for a thoroughly first-class article, at a lower price than the regular Lane standard tackle block. The "Junior" has a case made entirely of steel which is finished in black enamel or galvanized as desired. An efficient lock is supplied when required. This does not in any way interfere with the regular use of the block, but may be brought into action at any time by simply stepping back a short distance. No check cord is required and no part of the locking device touches the rope at all when not in actual use holding the load. These blocks may be used equally well horizontally or in any desired position. The Lane block holds the load anywhere, in any position, for any length of time. It is a great deal more convenient for handling comparatively light loads than the cumberous chain block, being much lighter and quicker in action as well as less expensive. It is just as easily handled as the ordinary block having no locking attachment, and adapted to just as many uses, but, what is more important, it is applicable to all sorts of requirements that the common blocks cannot meet at all. The same help can do more work if equipped with these blocks than with the common kind.

**Automatic Mechanical Stoking.**

A SYSTEM of mechanical stoking, automatic in the truest sense of the word, because automatic in the application of those principles vital to the economically successful utilization of fuel, describes the Jones "under-feed" system. The proportioning of the fuel supply and the air supply is a requirement absolutely necessary to produce a state of perfect combustion. This is a principle of physics and chemistry apparent in the burning of the common oil lamp, the ordinary Welsbach light, the kitchen gas range, etc. The Jones "under-feed" system applies this same principle in mechanical stoking, but going a step in advance, the steam pressure itself automatically proportions the fuel and the air to each other and to varying loads, therein exercising automatic control in its truest and most absolute sense. This feature of automatic regulation is secured through that portion of the Jones stoker equipment known as the Cole automatic attachment. The engine driving the blower is equipped with a regulating valve which, as the steam pressure rises above a certain point, throttles the supply of steam, thereby slowing down the engine and the speed of the blower, and consequently diminishing the output of air, or *vice versa,* should the steam pressure fall. On a stand located close to the blower is a bank of rotary disc valves, dependent in number upon the number of stokers installed, since each valve controls the admission of steam to a stoker cylinder. These valves are driven by a belt connected to the blower, the relative sizes of the two pulleys being calculatd so as to maintain

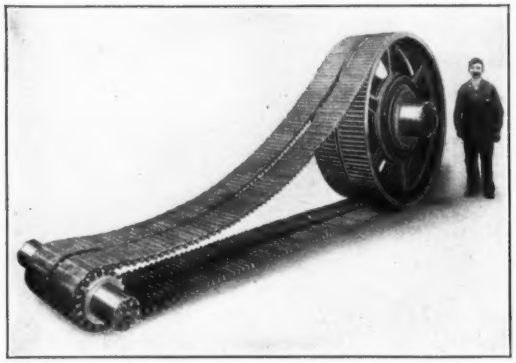


the proper proportion between the output of the blower and the rate of fuel feed. The immediate effect is to diminish the amount of air and to decrease the quantity of fuel admitted to the furnaces if the steam pressure rises, and on the contrary, to increase the amount of air and to increase the quantity of fuel if the steam pressure falls. The operation secures a correct proportioning of fuel and air, producing a clean and perfect combustion and eliminating smoke. It limits steam production and consumption of fuel to actual requirements, and being so completely au-

tomatic responds immediately to fluctuations in load, without attention or effort on the part of the operator. The Jones stoker is manufactured by the Under-Feed Stoker Company of America, Marquette Building, Chicago.

### Powerful Renold Silent Chain Drives.

AS showing the rapidly increasing appreciation of the many advantages of Renold silent chain drives for high-speed power-transmission, we mention two recent applications to different conditions in widely separated parts of the country. To the Seattle Brewing and Malting Company, Seattle, Wash., belongs the distinction of installing the largest Renold silent chain machinery; a single strand Renold silent chain drive having been put in to operate a Worthington centrifugal pump from a horizontal turbine at a speed of 1,755 feet per minute. The two chains for the brewing company are run side by side on single wheels 14 feet from center to center, the load being uniformly distributed by Dodge spring-centers on the driven wheel. The speed is 1,100 feet a minute. The pump drive measures 11 ft. 7 in. center to center, and has a capacity of 225 horse-power.

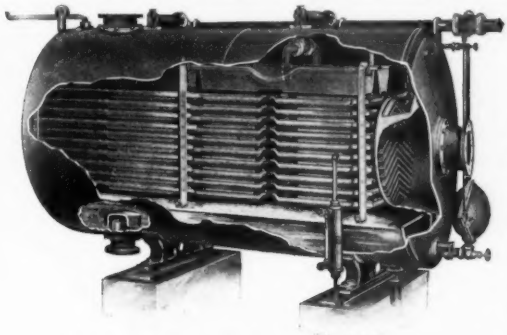


A Renold "silent" chain gear, as it is termed by the American manufacturers, the Link-Belt Company, consists of the "silent" chain and specially cut sprocket wheels. The links, stamped from high-carbon steel, are held together by hardened steel pins and bushings which make a practically indestructible joint and one which provides the greatest possible bearing surface for a given width of chain. It is due to the peculiar formation of the links and their method of contact with the wheels that the defects and racket common to the ordinary drive-chain are overcome. The stretch that may result from wear of the teeth is compensated for by the chain automatically assuming a larger pitch diameter while providing the surest possible contact with the driving and driven wheel, one-half the circumference of each wheel being always in mesh. As this continues to be the case, even when the chain becomes worn, it is evident that its maximum efficiency will be maintained, although the demands may be severe enough to completely incapacitate ordinary drives. The chain will run in either direction with uniform, quiet and positive action and is not adversely affected by hot or cold temperature, damp or oily situations.

### Hoppes Feed-Water Heater and Purifier.

WE illustrate herewith a Hoppes feed-water heater, class "R," in sectional side and sectional end views. Several new features have been embodied in the design of this heater, the principal one being the overflow dam as shown at the rear or exhaust inlet end. The form of shell used is cylindrical, the heads being bumped to a radius equal to the diameter, the object being to avoid flat surfaces so as to prevent pulsations due to the impulses of the exhaust. In class "R" the lower portion of the shell is cast iron, the upper portion being made of heavy flange steel. Class "T" is the same as class "R," with the exception that the entire shell is made of cast iron. The heater is provided with a series of multi trough-shaped cast-iron pans arranged in tiers, the object being to secure a large amount of heating surface. Owing to the trough shape given the pans, the water in flowing over the sides and edges follows the under side or bottom to the lowest point before dropping into the next pan below. The exhaust steam enters the heater through a very large oil catcher and in passing through the heater comes in di-

rect contact with the water flowing in a thin film along the under side of the pans, and as this process continues regardless of the amount of lime formation, the water is always heated to the highest possible temperature until the heater is ready for cleaning. The lime and other solids which may be held in solution in the water, will, when liberated by the heat, form mostly on the under side of the pans, while matter in suspension will settle inside them. The



water is introduced into the heater through a balanced valve controlled by a float in an independent float box and is evenly distributed in the feed troughs by pipes shown in the top of the heater. Each branch of the interior feed-pipe is provided with a reduced opening where it is flanged to the tee at the top, this opening being of correct size to distribute properly the water in the various pans. The distribution of the water by means of orifices of given size is not only made use of in each heater, but is available for feeding two or more heaters in multiple, and it has been found to be very effective. When it is desired to change the size of the orifices, this can be done by means of removable discs having the proper size openings and placed between the flanges of the "L" shaped feed-pipes and the tee at the top. These heaters are manufactured by the Hoppes Manufacturing Co., of Springfield, O., in sizes ranging from 50 to 32,000 horse-power.

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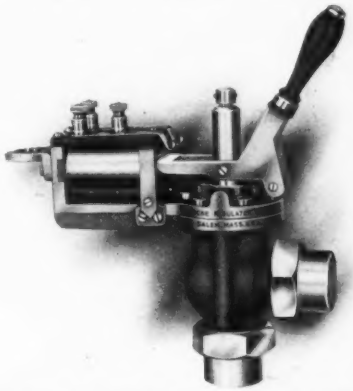
### The Locke Engine Stop.

THE Locke Regulator Company, of Salem, Mass., have on their engine stop and speed limit system what they call an independent valve to shut down the engine when it begins to race, or when it is desired to shut off the steam in case of emergency or any accident. They put into the steam pipe between the boiler and the engine, usually flanged to the throttle, an ordinary poppet valve with a piston. The piston and poppets are of one solid casting. The piston is fitted loosely in a cylinder so that steam passing through the valve to the engine is of equal pressure on top and underneath the piston, thus balancing it. By suddenly exhausting the steam from the top of this piston the excess of pressure below the piston, that is the full boiler pressure, drives the valve to. Steam is exhausted from the top of the piston through the electric valve shown in the accompanying engraving. This is attached direct to the cylinder. The electric valve is always closed, but may be tripped by means of a snap switch or other circuit closer. In connection with this system the Locke "speed limit" is belted direct to the main shaft of the engine. This is set at any predetermined number of revolutions, usually the danger limit, and when the flywheel attains this number of revolutions



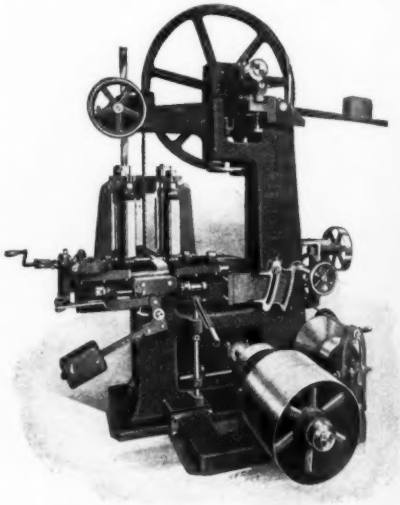
the "speed limit" makes an electric contact which trips the electric valve, and steam is instantly exhausted from the main valve and the supply immediately shut off from the engine.

The Locke valve is so constructed that

the supply of steam through the main is not reduced in any way and there is no danger of wire drawing, the steam area of the Locke valve being larger than that of the supply pipe itself. The Locke system does away with any encumbrance to the throttle, which is left perfectly free and independent. Once the Locke stop has operated it can be almost immediately adjusted for a second operation, by closing the throttle, latching the electric valve and opening the Locke main valve by means of a hand-wheel attached to it. The Locke system, by making no attachments to the throttle valve, does away with the danger of closing so tight that it can be opened again only with great difficulty. It is, moreover, made in many different sizes and the price varies according to the size of the supply pipe to the engine that is to be equipped. The electric part of the system is so arranged that it can be tested out without shutting down the engine. The Locke Regulator Company make their stops in several different types adapted to different conditions. It is possible to place the shut-off valve back in the main so that several engines may be protected with one stop. This, of course, reduces the expense of equipping each throttle with a separate device. Another form is the "combined throttle and engine stop," which is substituted for the throttle proper, and at the same time has all the elements of an engine stop.

### A New Band Resaw.

THIS is a new band resaw, embodying features that make is a splendid machine of medium capacity. The main frame is of improved design, cast cored throughout. The tension applied to the saw blade is the manufacturers' knife edge straining device, giving a perfectly even and uniform tension or strain upon the blade at all times, and acting instantly, thus greatly increasing the efficiency of the machine, and preventing the breakage of blades. The wheels are 42 inches in diameter, 3 inch face, entirely of iron and steel, improved in their construction; the lower one is made with solid web, cast hollow, circulating less dust and giving greater weight and momentum, and thus controlling the motion of the upper wheel. The upper wheel has a lateral adjustment made without stopping the machine, to cause the saw to run in its proper path on the wheel. The feed works consists of four rolls which open to receive any thickness of material up to 8 inches, and up to 24 inches wide. The rolls are self centering, also fitted with an improved device for quickly reducing thick lumber into picture backing, panels, etc., as the inside feed rolls may be instantly moved to or from the saw by means of a lever convenient to the operator, and gauged by a quadrant

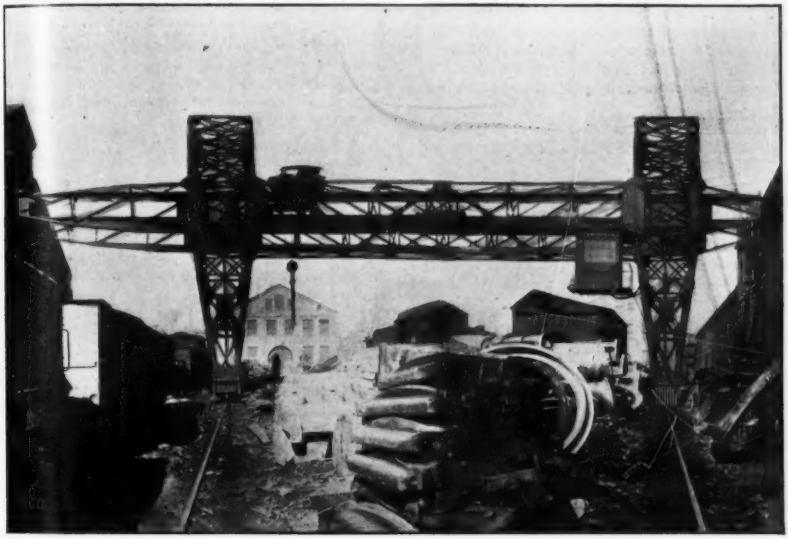


spaced in the most accurate manner, by eighths of an inch. The rolls may be tilted to an angle of 12°. The speed is controlled by an improved variable friction feed. The improved anti-friction saw guide is mounted on a square guide post, so designed that it cannot get out of alignment, and is counterweighted, making it easy to raise and lower. For further information regarding the tool, write the manufacturers, J. A. Fay & Egan Co., 212-232 West Front Street, Cincinnati, O.

### Niles Gantry Crane.

WE present herewith description and illustration of a large Niles electric traveling gantry crane, built by the Niles-Bement-Pond Company of New York, and lately installed at the South Chicago Works of the Illinois Steel Company.

The crane is of 15-tons capacity, and runs on a track laid on the ground 56′ 0″ center to center of rails with a cantilever extension on one end of 12′ 9″ and 28′ 3″ on the opposite end, making the total length of girders 97′. The girders are what might be termed lattice construction with auxiliary brace. The main girders are built up with universal mill plates and angles to form the top and bottom chords, fastened together by lattice angles. The auxiliary girders are of lattice construction so arranged as to secure great strength and rigidity and minimum wind surface, which girders approximately in the center between the runway tracks, where it is connected by a spur gear and pinion to the steel bridge drive shaft, which is carried in cap bearings and uniformly supported the entire length. This shaft is of sufficient strength to transmit the entire effort of the motor and to skid the wheels on the track. The cage is inclosed to protect the crane operator from the weather and fitted with drop windows and sliding door. A steel ladder is attached to one of the supporting columns reaching from the ground to a platform on the floor level of the cage



is of course important in yard cranes exposed to the elements.

The truck axles are of steel, accurately turned and ground, and revolve in bronze bearings with waste cellars beneath. The truck wheels are forced on by hydraulic pressure and prevented from turning on the axle by carefully fitted straight feathers or keys. The bridge drive shaft is connected to each pair of equalizing truck wheels by mitre gears, the vertical shafts being supported by roller thrust bearings. The bridge trucks are equipped at each end with a pilot to aid in removing any obstruction that may be on the track.

The bridge drive motor is located on the from which access is had to the cage through the sliding door mentioned above. This platform is surrounded by substantial hand rail, and an additional ladder is furnished reaching from the cage platform to the foot-walk extending the entire length of the bridge drive shaft, allowing easy access to all gears and bearings. The bridge drive motor is equipped with a powerful foot brake of the Post type, the brake shoes being withheld from contact with the brake drum except when applied by the operator, thereby eliminating friction and reducing the wear on the brake shoes and drum to a minimum. This brake is operated by a foot lever located conveniently in the cage.

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# IMPROVED MACHINERY

## New Processes and Appliances

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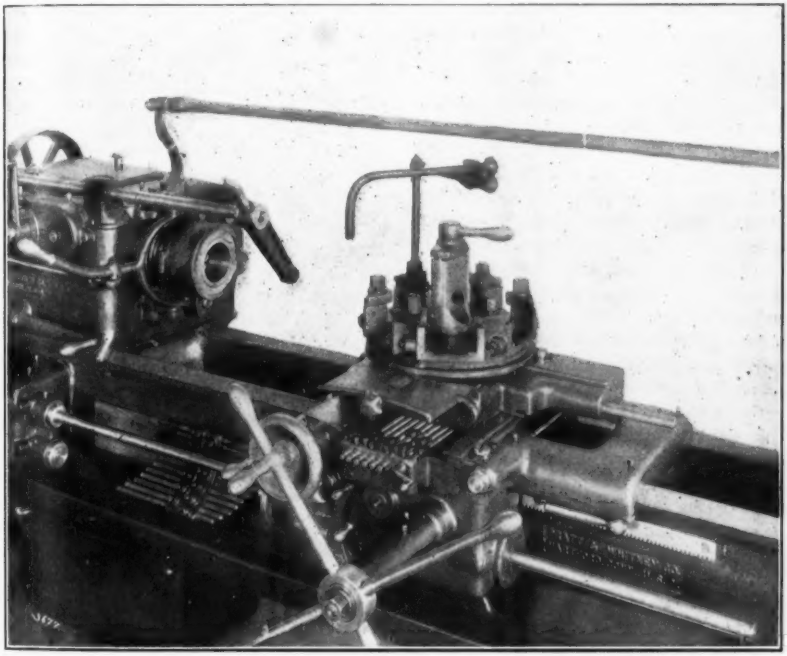
### "Open Turret" Lathe.

THE new Pratt & Whitney 2½ x 26 in. "open turret" lathe is a universal machine suitable for doing a great variety of work from the bar and on forgings and castings, without continually requiring special appliances and expensive cutting tools. To accomplish this purpose many new features, including a cross sliding turret, have been introduced. This machine possesses practically all the flexibility and adaptability of the engine lathe. The extreme rigidity, powerful spindle drive, quick changes of speed and feeds, heavy cross feeding turret and numerous adjustable stops, admit of narrower limits of error, as well as a marked reduction in the cost over work produced on the ordinary turret or engine lathe. The machine has a stiff head, with constant speed arranged for either direct-connected motor or countershaft drive by means of a single pulley. The turret is mounted on a slide, having both positive power and hand longitudinal and traverse directions. The machine is recommended for bar work up to 2½ in. diameter by 26 in. long, for castings up to 14 in. diameter and for cylindrical operations on work within these dimensions. An unusually heavy spindle of special steel, with cylindrical bearings, runs in bronze split sleeves. The thrust of the spindle is against an independent upright, cast solid with the head, and insures against any springing tendency under heavy end cutting strains. Provision is made for



taking up wear of spindle and end thrust. The direction and variation of the spindle to the work holding spindle are obtained by levers operating friction clutches. It is impossible to connect more than one set of gears with the spindle and main driving shaft at the same time.

The gears are of extra heavy pitch and of ample width to withstand safely the hardest usage. The head, which is stationary, is of box construction, the gears running continually in oil. The manufacturers, Pratt & Whitney Co., Hartford, Conn., will be glad to furnish further particulars.

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### Fireproof Residence Construction.

THE prospective homebuilder in his consideration of the various types of construction and materials available must ultimately base his decision on the bed rock of economy, namely, the most to be obtained in durability, beauty and comfort, from a given expenditure. In choice of plans for the proposed structure individual taste in choice of design in both exterior and interior arrangement may enter to an almost unlimited extent without serious impairment of the finished structure. Before this point is reached, however, comes the question of fireproof vs. old style construction. Here the builder is confronted by the necessity for a radical decision. Since fireproofing methods effectively and economically applied to residence construction are a rather recent development in the progress of the building industry, the ignorance of methods and comparative costs which generally obtains on the part of the laity should not be occasion for wonder. Therefore, in this connection, a word of comparison between old and new methods of construction may not be amiss.

The figures as given herewith were compiled by the New Century Contracting Company, 1 Madison Avenue, New York, from plans actually executed and, while of necessity but approximate, furnish authentic data of unusual value.

The New Century type of construction calls for terra cotta tiles laid in Portland cement, sustained by reinforced concrete girders and beams. Since the nearest analogy to this type of construction is found in the familiar brick and frame dwelling a comparative statement of approximate costs of the two is especially interesting. First as to floors, on a square foot basis: in the brick and frame structure the floor estimate must include the items of timber, finished floor, under floor, plastering (3 coats), lathing, cross furring (ceiling), bridging and paper. These items distributed in approximate proportion give an average estimate of 39½c. per square foot. In the opposed New Century structure, floor estimates include concrete and tile, finished floor, plastering ceiling (2 coats), and sleepers, totaling 32¾ cts. As to walls: the former, including brick veneer, timber, sheathing, plastering, furring, bridging and tie, lathing and paper totals 47 cts. per square foot, while the latter method, estimating on tile block, brick veneer and inside plastering gives 46 cts. Therefore, the brick and frame structure presents a total cost per square foot of 86¼ cts., while the New Century structure shows only 78¾ cts. per square foot. To the total saving to the builder of 11½ cts. —approximately 10 per cent.—of the latter method must be added the credit of absolutely fireproof qualities, together with the fact that it is air-tight, and that hollow tile, being a perfect non-conductor, retains cool air in summer and warm air in winter. This obviously gives in the one season added comfort to the occupant and in the other the advantage of economy in fuel consumption. It is worthy of note that, with specifications as above, both the exterior and the interior appearance of the two structures is identical.

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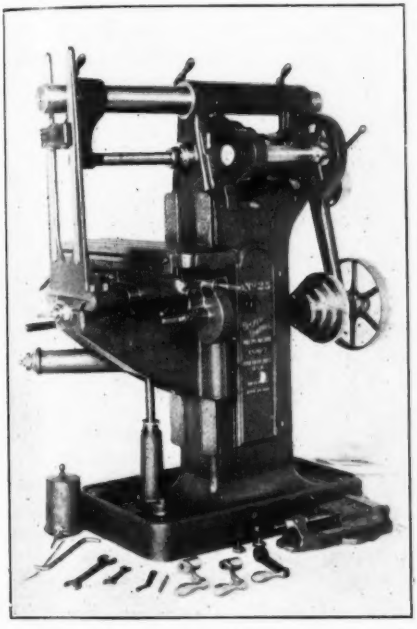
### Horizontal Milling Machines.

THE No. 25 and No. 26 milling machines, manufactured by the Becker-Brainard Milling Machine Co., Hyde Park, Mass., are made in two styles, backed geared and not backed geared respectively. In their design special attention has been paid to the requirements of the manufacturer of small machine parts, which are produced in large quantities, such as are found in small arms, typewriters, sewing machines and electrical works. In bringing out the new model especial attention has been given to the feed works, that they may be able to withstand the full power

of the driving belt, and at the same time give good service in the rough usage to which these machines are subjected. This new feed is driven by belts which get their motion from the spindle of the machine by means of a train of gears, so arranged that the velocity of the belt is sufficient to drive all feeds that the main belt will stand. The changes of the feed are obtained by four step cones and by interchanging the feed driving pulleys on the back of the machine, giving in combination eight changes from .007 to .100.



The table is operated by a worm and hobbed rack, the worm being driven by means of a worm gear of large size and a worm of coarse pitch. The arrangement for disengaging the feed is by a novel worm mechanism by which the worm is thrown out of mesh with the gear, and leaves in a path at right angles with its axis, overcoming the objection of the old style gravity drop worm of clinging to the gear by friction alone. It also equalizes the wear on the worm gear teeth. The worm is also engaged and thrown out of mesh by the same lever, making in all a neat, convenient and positive method of automatically disengaging the feed and stopping the travel of the table at a predetermined point. The table is also supplied with a hand quick return of 4 to 1 ratio, allowing it to be returned to the original position in the least possible time.

The knee of the new model has been lengthened sufficiently so that a harness brace may be used for the arbor and still have a cross range for the table equal to that of the old style machines. This harness is especially worthy of notice and makes for convenience as well as rapidity. It consists of a brace which is gibbed to the knee slide; a clamp that is fastened to the arbor support yoke in a manner that allows it to be swiveled around its centers, allowing the brace to be removed without removing any bolts. This clamp is made fast to the brace by friction which gives a more rigid hold than the old style bolt, washer and slot arrangement, at the same time allowing of a much stiffer brace. The convenience of this device will be at once appreciated by the operator. The arm, which is a solid steel bar, is adjustable lengthwise.

These machines are equipped with a rigid box knee and with a telescopic elevating screw, allowing the machine to be set in any position without regard to beams on floor construction, as the screw does not project below the floor line. The base of these new model machines has been designed on the same lines as the other Becker-Brainard machines, which are extra heavy, absorbing all vibration. The spindle cone and back gears are of the standard Becker-Brainard design, the spindle bearing being cylindrical in form, the wear being taken up by concentric compensating bronze boxes. The appearance of the machine has in no way been neglected, since new patterns were made throughout.

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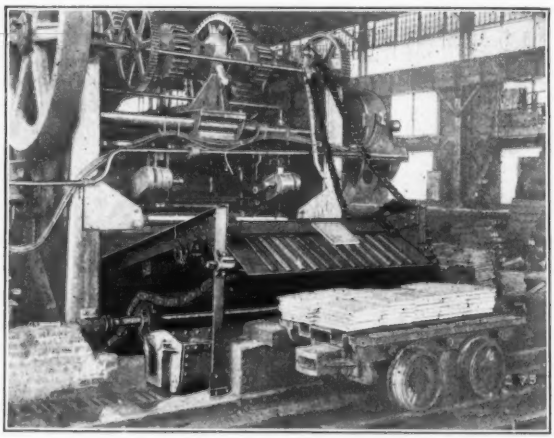
### Billet Conveying.

ONE of the oldest and most prominent firms closely identified with the rise and progress of the steel industry in America, is the Alan Wood Iron & Steel Company, whose establishment at Conshohocken, Pa., dates back eighty odd years. During these years this firm, along with other pioneers, has witnessed the introduc-

tion of many improvements in manufacturing and seen many mechanical devices for the facilitating of production and handling put into operation. The electrically-operated conveying equipment for expediting the movement of hot and cold billets at their Ivy Rock mill, indicates that even if the firm is old, as years are counted, it is not lacking in up-to-date equipment for increasing facilities. A look into the rolling mill shows that when the ingot is of equal heat from center to corners, it is brought to a transfer table by a crane. The movement of the table is controlled by an operator shielded from, but in plain view of, a tri-section roughing roll. The table

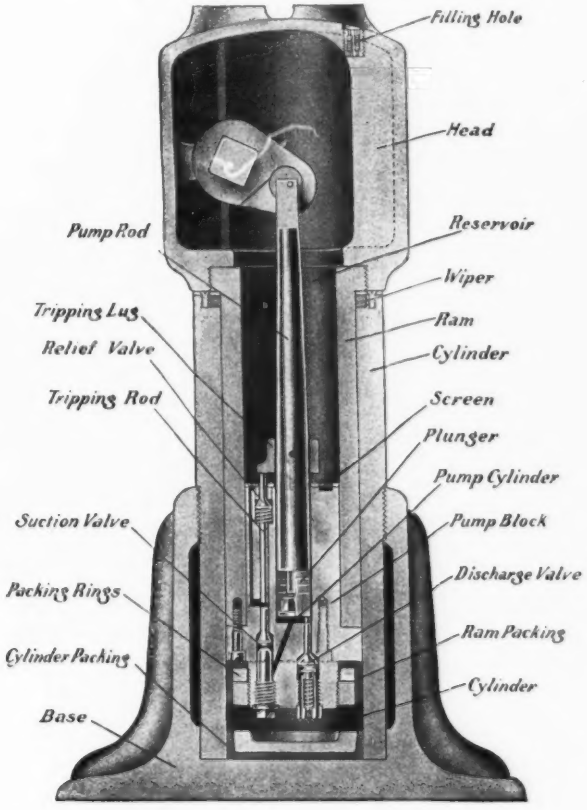


takes the ingot to the roll, through which it is passed forward and backward several times. The lengthened ingot is then passed to the second section and again rolled, the proper length and thickness being finally obtained by a few passes through the third section of the roll. The cutting of the cold steel bars is done on the opposite side of the mill, the long bars being brought to the cutter by a transfer table controlled, as in the rolling, by a man in plain view of the cutter. When the current is turned on, a certain length of the bar passes under the cutter, the part remaining on the table being automatically clamped to hold the bar securely while being cut. The cutter comes down with a pressure of 500 lbs. in the cylinder and the severed portion of steel drops onto a Link-Belt inclined apron-conveyor which delivers the billets to cars running on a narrow-guage track.

### A New Hyraulic Jack.

WE illustrate in cross-section a hydraulic jack of the inside pump type, such as is being quite extensively used by the United States and other governments for ship-yard and similar uses. This jack consists essentially of two hollow concentric steel cylinders machined to sliding contact with each other. The outer cylinder is fixed in a steel base and the joint packed with a copper cup to withstand great pressure. The inner cylinder is closed at the top by the "head" and at the bottom by the "pump block," thus making a reservoir, in which the filling liquid is held. The pump block derives its name from the small pump contained therein and connected through the piston rod to the lever outside. Movement of the lever forces the liquid through suitable valves into the space between the lower end of the pump block and the bottom of the outer cylinder, thus pushing the base and head apart with a gradual movement. The delicate parts of a hydraulic jack must be designed to be secure from injury and if good material and the highest mechanical skill are not incorporated into their manufacture, they will become useless after short service. Provision must be made to prevent leakage, to prevent undue wear and to provide easy access to the interior, especially to the suction and discharge valves in the pump block. Most trouble from leakage in hydraulic jacks is caused, first, by the liquid running from the filling hole when not in use and laid in a horizontal position, and second, from leaking or blowing out of the packing at the lower end of the outer cylinder. In older types of hydraulic jacks the filling hole contained a filed groove to allow the air to enter and escape as the ram was raised and lowered. While the purpose was accomplished, liquid was

found to escape also when the jack was resting in a horizontal position. In the jack we are here describing the filling device consists of a plug with two valves, one opening inwardly and the other outwardly, both being held to their seats by springs of sufficient stiffness to prevent the liquid escaping as the jack is laid down; leather packing may be perfectly tight when new, but it will shrivel and crack in time, causing a steadily increasing leakage which may result in an accident. The leather must be renewed frequently and as it difficult to reach the renewal is troublesome. In the Joyce-Cridland jack this cup packing is of copper, accurately turned to fit




but sufficiently elastic to allow the entrance and escape of air to and from the cistern as the ram is worked up and down. This free and uninterrupted movement of the air is essential to proper action of the pump.

Leakage at the cylinder end may result from two causes. As a rule a leather cup packing is used here and with this construction it is impossible to make a joint which will stay tight permanently. A

the bore of the cylinder. The inside of the cup is turned to a slight taper and after being placed in position a plug or packing ring having the same taper is forced into it, swagging the sides of the cup against the cylinder walls and making tight, permanent joints which need never be touched.

Another source of trouble heretofore existing in hydraulic jacks was due to dust, metal chips, or sand lodging on the ram when it was run out. If these were not

removed on lowering they were carried down between the ram and cylinder, cutting grooves in both and doing irreparable damage to the jack. This trouble is prevented in the present jack by placing a wiper around the ram at the top of the cylinder. The wiper is saturated with oil and, in addition to wiping off any dirt from the ram as it passes down into the cylinder, lubricates the sliding surfaces, keeping them smooth and unscored. Should this foreign matter be allowed to enter the cylinder it would also cut the packing on the pump block and get under the valves rendering them leaky. The filling liquid may also contain dirt and grit and it is of the utmost importance that the liquid should be strained before it leaves the cistern on its way to the pump. Otherwise, the particles would soon prevent the proper seating of the valves, ruin the contact surfaces and otherwise interfere with the successful working of the jack. Trouble of this nature is prevented by a fine screen on top of the pump block, through which all the liquid must pass before reaching any delicate working parts and surfaces. Although there may be a considerable amount of dirt in the liquid it is prevented from reaching the valves. It may be noted from the cross-section that the suction valve is so located that the liquid may be taken from the extreme side of the bore of the ram. This permits the use of the greatest possible amount of liquid, a very important point when using the jack in a horizontal position, since the limit of the stroke depends upon the quantity of liquid which can be forced into the cylinder. The path of the liquid from the cistern to the main cylinder is as follows: When the pump plunger is raised, the suction valve is drawn from its seat and oil passes through the filter screen, through the passage shown in the extreme left of the pump block, past the suction valve and into the pump cylinder. When the plunger is lowered the suction valve closes, and the liquid forces the discharge valve open, passes by it and through the openings in the side of the valve cap into the cylinder, thus raising the ram. The illustration shows the plunger at the lower end of the normal stroke in which position the end of the pump rod touches the discharge valve stem and at the same time the tripping lug further up on the pump rod comes into contact with the suction valve stem. A slight additional length of stroke trips the jack, opens both these valves and allows the liquid to pass back to the cistern by the same channels through which it came. A lug on the operating lever coming in contact with a stop on the outside of the ram head prevents the stroke from being prolonged so far that the end of the plunger would touch the valve openings. The speed at which the jack may be lowered in this way is regulated by the pressure which the operator exerts on the lever. A valve is provided on the upper end of the tripping rod which prevents the pump taking air when the level of the liquid has fallen below the tripping rod. This valve is held by a spring of sufficient stiffness to prevent its unseating under the suction of the pump plunger, but it yields to the positive action of the tripping lug. The tripping mechanism is positive and under the direct control of the operator. It does not depend upon springs and cannot fail to act. In starting, the lever is turned with the lug pointing up, raised slightly to remove the pressure in the pump cylinder and to allow the suction valve to fall from its seat, then lowered slowly to allow the liquid to flow back from the pump cylinder to the reservoir.

For convenience in attention both the suction and discharge valves are placed in the end of the pump block so that by taking the ram out and unscrewing the caps which cover them they are immediately exposed. The discharge valve spring is protected by a casing and operates through a plunger which holds the valve normally to its seat. The casting protects the spring from the violent current of the liquid which in other makes tends to jam the unprotected spring out of shape.

The material which goes into the parts under strain must be of high tensile strength and only metals best fitted to resist wear are used. The cylinder and ram are forged and machined from solid high-carbon, open-hearth bar steel and the sliding surfaces contain no welds or seams. The head and base are crucible steel castings and the pump block is milled from a solid bar of Tobin bronze. The valves are

made from phosphor bronze and are compressed to render them durable. The valve cups, the discharge valve plunger, and discharge valve spring are also of bronze, making a non-corrosive combination which will not cause trouble from the use of an improper filling liquid. Manufactured by The Joyce-Cridland Co., Dayton, Ohio.

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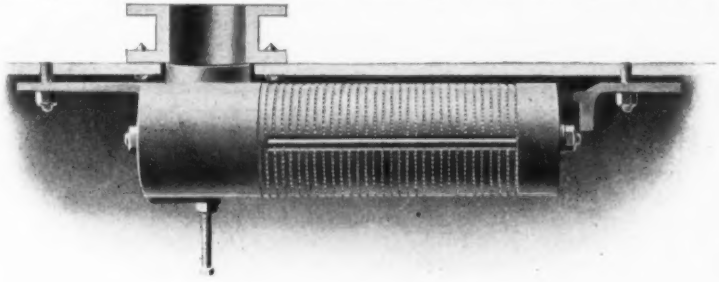
### Dry Steam at the Boiler Outlet.

THE importance of dry steam at the boiler outlet is generally recognized, but it is a condition that in these days of quick-steaming and over driven boilers has been very hard to obtain. In consequence the steam plant of average size has been



throwing away annually many hundreds of millions of heat units in the form of water drawn from the boilers with the steam. Figuring accurately, it is shown that this loss on a 500 H.P. plant in service ten hours a day for 300 days a year amounts to 4,869,000,000 heat units for every 1 per cent. of moisture delivered with the steam; this number of heat units, figured on a conservative basis, represents a consumption of 20 tons of coal per year. The Potter mesh separator has been designed to overcome this loss, by attacking the trouble at its source and separating the water from the steam before it reaches the boiler outlet. That it is successful in doing so is shown by a test, printed herewith, which speaks for itself, the conditions before installing the separator having been very bad. The test was conducted at the Great Northern Hotel, Chicago, Ill., March 15, 1907.

The accompanying cut shows the separator installed in a boiler, and it will be seen that it consists of a number of wire screens separated by light iron distance rings, the whole bolted together and connected up to the boiler outlet. The water carried in suspension in the steam is deposited upon the wire screens and returned by gravity to the water in the boiler. The separator, which is manufactured by the Potter Separator Co. of Newburgh, N. Y., is so constructed that distance rings and wire screens can be removed with ease, without breaking the outlet connection, for the purpose of brushing off the screens when they become too much coated with the foreign matter which is carried with

| Time. | Gage Press. | Upper Man'r reading. | Lower Man'r reading. | Temp. Fahr. | Total. Manometer. | Quality, %. |
|---|---|---|---|---|---|---|
| 4.00 P. M. | 140 | .3″ | .3″ | 284 | .6″ | 98.861 |
| 4.15 " | 136 | .3″ | .3″ | 287 | .6″ | 98.99 |
| 4.30 " | 133 | .3″ | .3″ | 286 | .6″ | 98.99 |
| 4.45 " | 126 | .3″ | .3″ | 286 | .6″ | 99.1296 |
| 5.00 " | 127 | .3″ | .3″ | 286 | .6″ | 99.107 |
| 5.15 " | 130 | .3″ | .3″ | 287 | .6″ | 99.103 |
| 5.30 " | 125 | .3″ | .3″ | 285 | .6″ | 99.092 |
| 5.45 " | 126 | .3″ | .3″ | 284 | .6″ | 99.019 |
| 6.00 " | 127 | .3″ | .3″ | 285.5 | .6″ | 99.0783 |
| | | | Average..... | | | 99.0411 |

the water. The need for this cleaning occurs only at long intervals.

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**Rope Drive for Machine Tools.**

HITHERTO rope drive has been practically inadmissible for machine tools of the variable speed type, such as lathes, shapers, drills and drilling tools, because speed changes were usually procured by coned pulleys modified by throwing the back gear in or out. While a power rope can be shifted from one groove to another, the operation is so tedious and time-consuming that it cannot be applied to the often swiftly succeeding speed changes of modern machine shop practice. Hence, belts have generally been used for these carrying transmissions, though it is true that some lathes have for years been run with rope driving, using fast and loose rope sheaves or pulleys. Of late a number of single pulley drives have been introduced on tools of this class in which speed changes are effected by lever-controlled change gears. This system has the great advantage of increasing the power delivered to the cutting tool by high initial belt speed. With a constant speed for the driving shaft, cutting power is the same at high or low speed. Speed changes can be made very quickly and at a far greater range of changes than is obtained with stepped pulleys. In some of the latest types, increments of 10 per cent. are provided for. This design avoids the countershaft, and wholly eliminates the chance of injury to the workman in traversing the belt by hand. Injuries from this source are probably the most common in machine shops. Where wire belt lacing devices are used a wire end improperly tucked in has often caused frightful gashes to the operator's hand.

Though we are not accustomed in this country to see driving rope shifted from an idle to a working pulley, it can be done just as well with a belt, and is a matter of common occurrence in England. In a number of large cotton mills in the Lancashire district the power is conveyed from a line shaft running the whole length of the room to numerous ring frames by means of ropes instead of belts, the ropes operating on fast and loose pulleys mounted within guard boxes. This arrangement affords an excellent illustration of the reduction in weight on the shafting afforded by the substitution of rope driving for belting. The 3½ in. belts need pulleys 4½ in. face, while the ropes used are only 13/16 of an inch in diameter, and work in sheaves occupying with their flanges not more than one inch space laterally. In this combination a shifting arrangement is used, illustrated herewith, which could well be adapted for the drive of constant speed machine tools. The idle or loose

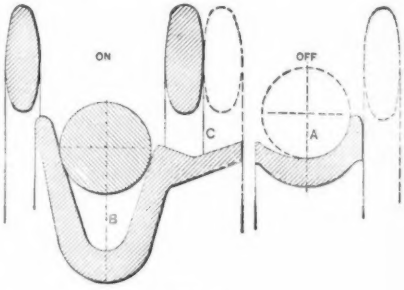


FIG. I.

sheave A has practically all of its flange cut away on the side towards the working or fast sheave B. To throw the machine into action, a curved rope shifter or fork is used, shown in section and perspective. It is bent to the curve of the sheave with just enough clearance above the sheave flanges to allow the rope to pass, and is operated with a pivoted hand lever as usual with belting. As the arm of the fork engages the driving side of the rope, it pushes the latter clear of its reduced flange onto the intermediate groove C, cut in the fast sheave. On this it gains a revolution while passing to its work, which insures a gradual starting or stopping and provides a most sensitive action. The shifter continuing towards the left, passes the rope into its working sheave B, whence it is readily forced out by reverse movement of the fork whenever the machine is to be stopped.

Besides being exclusively used in English cotton mills, fast and loose driving is also used on lathes, mortar mills and in milling. It has been argued against rope driving of constant speed power tools provided with change speed gears that,

because the driving shaft is usually directly above the machine, it would be necessary to use the American or continuous carriage and idler sheave. In answer to this it is claimed that the driving shaft may be set sufficiently to one side over the tool to make such an angle with the vertical that the multiple, or English system, could be used with sufficient natural tension. As the proposed innovation is a radical departure from existing practice, there is no need of adhering to any part of such practice not made intrinsically necessary by operating conditions. The principal reasons for placing driving shafts directly over lathes are to secure

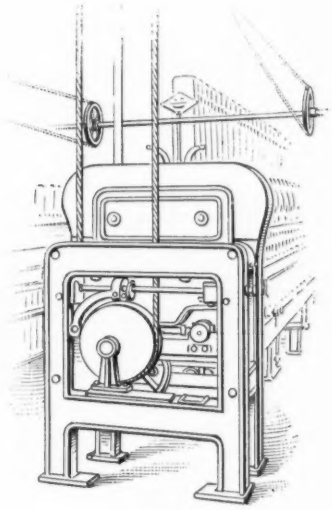

FIG. 2.

minimum lengths of belting, owing to its high cost and to keep the passage way between tools clear overhead. With rope drive the cost is so much reduced as compared to belting that even double the length will still be much cheaper than the belt. It might not be amiss to adopt an entirely different arrangement with rope drives of power tools by carrying the power up through the floor from line shafts run underneath. This would very much shorten the length of drives, clear the overhead space and enable the shifter or fork to operate on the driving side of the rope from below. It would have the disadvantage of increased fire risk from the openings made necessary in the floors. Another objection is that to secure sufficient speed, the sheave on the lathe would have to be so small in diameter that quite a number of ropes would have to be used, which would make the face of the sheave as wide, if not wider, than a belt pulley for the same power. As the drive contemplates a lathe equipped with gears for changing speed, this objection falls away because one single rope can carry a great deal of power to a tool provided with a large sheave, and as gearing is going to be used anyhow, the speed of the first driver shaft can be varied at will. That almost any machinist can lace a belt, whereas practically none can splice a rope is an objectionable feature of constantly diminishing weight, because, in the first place, a rope does not need to be spliced nearly as often as a belt needs to be laced, and with the rapidly increasing use of transmission rope, the practice is growing of having at least an expert drive rope splicer attached to each large industrial establishment.

Rope transmission is comparatively so new a feature of engineering that its possibilities well deserve research and testing, because in every case where it has been tried under seemingly most unfavorable conditions, as in the Holsman automobile drive, it has given results justifying the enthusiasm of its sponsors.

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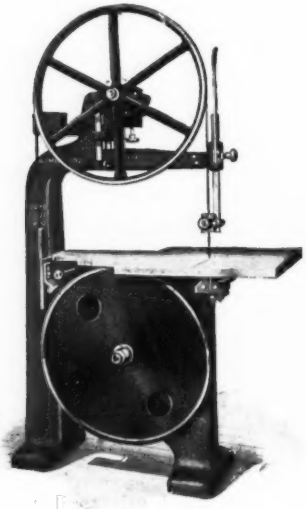
### Fay & Egan Band Scroll Saw.

THE No. 192 Fay & Egan band scroll saw machine will appeal strongly to those wishing a band saw for a large variety of light or heavy work. The column is a substantial cored casting, its form being such as to give greatest freedom of movement to the operator. The wheels, which are 33 in. in diameter, are taper fitted onto the shafts, which run in long bearings. The upper wheel is carried on a saddle vertically adjustable by means of a hand-wheel, convenient to the operator, for varying the length of the saw blade. The bearing is mounted on a knife edge and fitted with the patent sensitive straining device, shown herewith, maintaining an even tension of the blade at all times.

The lower wheel is solid webbed, and its weight gives it a momentum which continually controls the lighter upper wheel.

The machine has an iron table 24 x 26 in., which may be tipped to any angle up



to 45 degrees and is securely locked in any position. The height from the floor to the top of the table is 37½ in. The upper guide, which is the new roller type, is carried on a square bar, insuring permanent alignment. It has a vertical adjustment for any distance up to 12 in. above the table. The height of the machine over all is 6 ft. 9 in. The manufacturers, J. A. Fay & Egan Co., 212-232 West Front Street, Cincinnati, O., will send further details on request.

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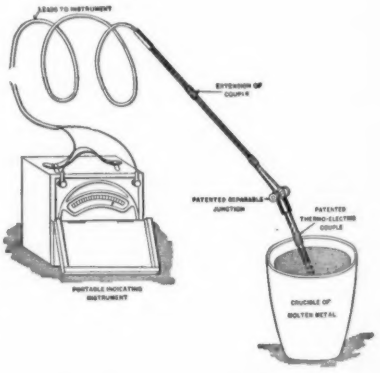
### A Portable Pyrometer.

IN manufacturing processes and in metallurgical work molten metals and alloys are extensively employed, especially for the making of castings from moulds and it is important that the metals be mixed, alloyed and poured at the proper temperatures in order to obtain the best results. The special form of pyrometer described here has been designed to meet the practical requirements of every day shop practice. The portable indicating instrument may be carried in the hand and within two or three seconds the temperature of the molten metal may be taken. The possibilities and great value of an instrument of this kind will be fully appreciated by those who are interested in foundry work of any description. The outfit complete consists of a portable indicating instrument connected to a special thermo-electric couple, the two elements of which are disconnected and left without insulation. When the tips of these elements are slightly immersed into the molten metal an electric connection is made and the reading on the instrument will be the same as if the couple had been originally joined. The general arrangement of the parts forming the outfit for this class of temperature measurements is shown in the accompanying diagram as it would be applied for taking the temperature of a crucible of molten metal just before pouring. The advantage of this plan is that the tips of the wires forming the elements almost instantaneously assume the temperature of the molten metal and time lag error is eliminated. This form of couple has been most successfully applied to the measurement of molten metals as cast iron, copper, aluminum, brass, bronze and other alloys.

When the tip of the couple becomes worn away by continued use, a fresh portion is exposed to the molten metal and the read-




ing will be the same as if the couple had not been reduced. A separable junction is provided, as shown in the diagram, so that fresh tips can be conveniently applied before enough of the couple has worn away

to appreciably affect the resistance and cause an erroneous indication on the instrument. These instruments are being successfully used by a large number of manufacturers. They are manufactured by Wm. H. Bristol, 45 Vesey Street, New York City.

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**Humidifying and Cooling in Textile Mills.**

THE subject of cotton conditioning has long been one of vital interest to all mill operators. This subject was well treated by Mr. W. H. Carrier, M.E., of the Buffalo Forge Co., Buffalo, in a paper which he read before the annual convention of the American Association of Cotton Manufacturers at Philadelphia recently. The main purpose of this address was to show both the scientific principles applying to the artificial conditioning of cotton mills and to describe a system of conditioning which would embody such principles most effectually. The system described is a fan system and has been entirely successful in meeting the widely different sets of conditions during cold, and hot, dry weather. It humidifies and cools in summer by artificial ventilation with cold saturated air and humidifies and heats in winter by first saturating the air at proper temperature and then heating air after saturation to a temperature sufficient to maintain the required temperature and humidity conditions in the room. The apparatus consists of a humidifier, fan and heater and a system of ducts for the distribution of the humidified air. The humidifier consists of a large air chamber in which spray is atomized under high pressure by means of a large number of cyclone nozzles. The air is thus filled with an extremely fine mist in large volume and thereby brought to the point of saturation. The free moisture is then separated from the air by an eliminator. The design of the latter and of the spray nozzle are the two principal features which make this apparatus a success. The construction of the nozzle is such that it is practically impossible to clog it with foreign material, the smallest hole being 3/32 of an inch in diameter, yet it throws a perfectly atomized mist by reason of the centrifugal principle upon which it operates. The very difficult function of separating this finely atomized spray from air current at high velocity is performed by an eliminator of special design. The fan and heater are of unusual design and need no special mention —the only variation from the standard being that the air is by-passed around the heater during the summer, thereby avoiding the frictional resistance of the same.

The Buffalo system may be easily applied to a fan system already installed. The size of fan ordinarily used is insufficient to care for summer conditions and the apparatus can be successfully operated only during cool weather. Old plants, however, can easily be remodeled by the installation of a larger fan and putting in additional ducts. A considerable advantage in employing this method of heating is that it avoids a great amount of piping strung along the ceiling which is not only inefficient in heating but catches dust and lint which eventually drops off and causes unequalities in the yarn. The principal advantages of the system are: that it humidifies and cools the air before, not after entering the room; non-dependence on uncertain and insufficient air leakage in and out of the mills for cooling effect; humidified and cooled air delivered to work rooms under slight pressure so as to avoid drafts. Inward leakage of hot air in summer and of cool dry air in winter are thereby prevented, an essential feature for uniform humidity and temperature conditions. The rooms are cooled without opening the windows in summer, thereby avoiding window drafts, disastrous to fine yarns. The one system cools the spinning room within 5° of outside temperature in summer, insures uniformly heated and regulated temperature in winter, maintains and controls the humidity in all parts of the mill at a desired degree both winter and summer. The apparatus is located centrally, permitting each department to be controlled from one point at the apparatus or at each room as preferred. One man can easily care for the entire humidifying, cooling and heating equipment.

The Buffalo Forge Company will cheerfully furnish this address in its entirety to any who are interested and any other information on this apparatus, which may be desired.

# NEWS SUPPLEMENT

The Engineering Magazine—August, 1907

### Personals.

—The Under-Feed Stoker Co. of America, Chicago, announces a change in its official directorate whereby Fred A. Daley, heretofore Treasurer and Manager of the Company, becomes President and Treasurer.

—Messrs. Maurice Gesundheit and Henry Osgood have entered the unique field of manufacturing engineers and business methodizers. The firm's name is Gesundheit-Osgood Company, with offices at 43 Cedar St., New York.

—Oscar Winter, who for more than six years has been steam expert of the National Tube Company, formerly the Lorain Steel Co. of Lorain, O., has opened a consulting office in the Rockefeller Building, Cleveland, O., where he will give special attention to expert work in steam engineering.

—Announcement is made of the appointment of William D. Ennis as Professor of Mechanical Engineering in the Polytechnic Institute of Brooklyn. Professor Ennis, who is most widely known through his contributions to the technical press, is a graduate of the Stevens Institute and from 1901 was engineering adviser to various Rockefeller interests in the Northwest and elsewhere, including the American Linseed Co. Since 1905 he has been exclusively engaged on special power investigations for the American Locomotive Co.

### Industrial Notes.

—B. F. Sturtevant Co., Boston, have recently sold a large equipment of their electric propeller fans for export to Yokohama.

—The Buffalo Forge Co. have changed their Pittsburg office from 1101 Diamond Bank Building to 613 House Building. E. P. Leadbetter is manager.

—The Sprague Electric Co., New York, has opened a district office in the Hennen Building, New Orleans. This office is under the management of F. V. L. Smith.

—Dodge & Day, engineers and constructors, Philadelphia, have commenced work on an extension of the York, Pa., Street Railway system, from York to Hanover.

—The Boston branch of The American Mfg. Co. has outgrown its original quarters in the Post-office Square Building and taken larger offices in the Ames Building. W. F. Morgan is manager of the Boston office.

—The Western Electric Co. has put in at 230 Lee Street, Atlanta, Ga., a complete stock of general electrical supplies, and at that point had established a supply organization to care for the Southeastern trade.

—The Power Specialty Co., New York, report recent sales of 120 Foster superheaters, aggregating 42,000 H.P. These superheaters are to be installed in B. & W., Stirling, Edge Moor, Heine, Franklin, Atlas and other boilers, including a number of return tubular boilers.

—A system of drying belting is being installed for the Rossendale & Reddaway Belting & Hose Co., Newark, N. J., by the B. F. Sturtevant Co., Boston. The equipment consists of a large fan with steam heater through which air is drawn, heated, and forced through ducts to the desired points.

—Bucyrus Co., So. Milwaukee, has just issued an elaborately illustrated reprint of President Roosevelt's message on the Panama Canal, transmitted to Congress under date of December 17, 1906. This company has furnished all the steam shovels ordered by The Isthmian Canal Commission up to May 1, 1907.

—The Hercules Special, the new machine recently put upon the market by the Century Machine Co., Rochester, is meeting with success. This machine is smaller than the regular Hercules, but is built exactly the same. It was put out to meet the demand for a smaller machine and will make blocks from 2 inches up to 32 inches in length.

—The Bristol Co., Waterbury, Conn., are distributing a bulletin entitled "Power Economy" by H. P. Dennis, M.E., treating of power plant equipment. Mr. Dennis is recognized as an authority on this subject. The Bristol Company will be pleased to send copies of this bulletin to interested parties.

—The new buildings for S. L. Allen & Co., Philadelphia, which are being designed and constructed by Messrs. Dodge & Day, are progressing rapidly. These buildings are being constructed entirely of reinforced concrete and the centering has already been removed from the two lower floors so that the buildings will soon be ready for the installation of machinery.

—Kitts Manufacturing Co., Oswego, N. Y., has increased its capital stock from $40,000 to $100,000 for the purpose of enlarging its facilities for meeting the increased demands for the steam specialties made by this company. The Hunter Fan & Motor Company of Fulton, N. Y., have acquired an interest in this firm, and a new plant will be erected this fall.

—Mechanical draft for boilers is being installed by the B. F. Sturtevant Co., Boston, for Kitson Machine Shops, Inc., Lowell; R. B. Whitacre & Co., St. Paul; State Hospital, Morganton, N. C.; Bemis & Call, Springfield, Mass.; General Chemical Co., Dundee, N. J.; General Chemical Co., Laurel Hill, L. I.; Lovegrove & Co., Inc., Philadelphia; and International Paper Co., Otis Mill, Chisholm, Maine.

—Among sales of recent date made by the Under-Feed Stoker Co. of America, Chicago, are two of considerable importance effecting the textile industry. The Amoskeag Mfg. Co. has placed an order for 28 Jones stokers, making a total of an even 100 Jones stokers purchased by that company and its allied interests. The York Mfg. Co., Saco, Me., has contracted for an additional 12 stokers which will make a total of 33 Jones stokers in their plant.

—J. H. Wagenhorst & Company, Youngstown, Ohio, manufacturers of electric blue printing machines, report the following partial list of sales: Cleveland Crane & Car Co., Wickliffe, O.; Warren Steam Pump Co., Warren, Mass.; Vulcan Iron Works, Detroit; A. O. Smith Co., Milwaukee; Traylor Engineering Co., New York; John S. Cole, Charleston, W. Va.; Carnegie Steel Co., Youngstown, O.; District Pumping Station, Washington, D. C.; C. P. & E. R. R. Co., Willoughby, O.; Eugene Dietzgen Co., Chicago; Pardee Bros. & Co., Lattimer Mine, Pa.; Tennessee Coal, Iron & R. R. Co., Bessemer, Ala.

—Anderson Forge & Machine Co., Detroit, was organized one year ago last February and since that date have been adding to their equipment as fast as they could secure shipment of the machinery and have about completed the installation of their additional equipment for manufacturing drop forgings, crank shafts and tools. The plant is now equipped with 21 hammers of various styles and sizes enabling them to manufacture a large range of drop forgings for machinery and automobile manufacturers. They have erected a new building for a die room 40′ x 150′, two stories high, of heavy construction. This building was especially designed for die making and have also installed a new steam hammer which enables them to do a considerable amount of large general forging, and their machine shop equipment is especially arranged for the manufacturers of engine crank shafts.

—The New York State Steel Co., Buffalo, after a thorough trial of a 4,000 H.P. We-Fu-Go water softening and purifying system manufactured by Wm. B. Scaife & Sons Co., Pittsburgh, have placed an order with them for another 4,000 H.P. system to be added to their present system, making a total of 8,000 H.P. Other sales reported by Wm. B. Scaife & Sons Co. are:—The Andrews Steel Co., Newport, Ky., 3,750 H.P. We-Fu-Go system; National Home for Disabled Volunteer Soldiers, Dayton, one 300,000 gallon per 24 hour We-Fu-Go system, two 1,200 gallon per hour We-Fu-Go systems; American Sheet & Tin Plate Co., Pittsburgh, 5,000 H.P. Scaife system; Rochester & Pittsburgh Coal & Iron Co., DeLancey, Pa., 1,500 H.P. We-Fu-Go system; Youngstowns Sheet & Tube Co., Youngstown, 15,000 H.P. We-Fu-Go system; Pennsylvania Salt Mfg. Co., Natrona, Pa., 5,000 H.P. We-Fu-Go system; Norwalk Iron & Steel Co., Norwalk, O., 1,000 H.P. We-Fu-Go system; McConway & Torley Co., Pittsburgh, 1,000 H.P. We-Fu-Go system.

# NEW CATALOGUES AND TRADE PUBLICATIONS

*NOTE—The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index. See page 11.*

**Boiler Tube Cleaners.**

VULCAN SOOT CLEANER CO., Du Bois, Pa.—Well printed catalogue illustrating and describing this company's methods and apparatus for eliminating a great waste in operating all types of water-tube and return tubular boilers. Also contains numerous testimonial letters and partial list of users. 6 by 9 in.; pp. 32.

**Box-Car Loaders.**

CHRISTY BOX-CAR LOADER CO., Des Moines.—Catalogue devoted to an illustrated description of box-car loaders for loading coal, ore or other minerals into box or stock cars. 7 by 9½ in.; pp. 42.

**Concrete Forms.**

UNIVERSAL FORM CO., New York.—Pamphlet illustrating and describing steel clad, self-aligning forms for monolithic concrete construction. 6 by 9 in.; pp. 16.

**Concrete Industrial Plants.**

BALLIGER & PERROTT, Philadelphia.—Catalogue illustrating some examples of reinforced concrete industrial plants and business buildings recently constructed by this company, together with brief descriptions of the systems of construction. 6 by 9 in.; pp. 48.

**Crushing Machinery.**

KROM MACHINE WORKS, New York.—Catalogue treating of crushing machinery, together with dimensions, capacities and prices. Illustrated. 6 by 9 in.; pp. 26.

**Dump Cars.**

CONTINENTAL CAR AND EQUIPMENT CO., New York.—Catalogue E devoted to an illustrated description of dump cars for railways, sand pits, brick yards, phosphate plants and contractors engaged in the removal of large quantities of earth, rock, sand, gravel, etc. 9 by 6 in.; pp. 32.

**Electrical Equipment.**

GENERAL ELECTRIC CO., Schenectady, N. Y.—Bulletins Nos. 4493-8-9, 4502-3-7-8-9-10-11-14 and 15 illustrate and describe controllers, wattmeters, rheostats, switches, generator sets, flat irons for laundry work, motors, train lighting, rheostat switches, lightning arresters, indicating instruments, and cylinder controllers respectively.

**Feed Water Heaters.**

MARION INCLINE FILTER & HEATER CO., Marion, O.—Catalogue illustrating and describing the Marion system of feed-water heating and purification. 6 by 9 in.; pp. 30.

**Feed-Water Heaters.**

HARRISON SAFETY BOILER WORKS, Philadelphia.—Booklet concisely summarizing what a Cochrane feed-water heater is. Examples are given of practical applications at coal mines, paper mills, in condensing and non-condensing plants, and in steam power plants generally. Illustrated. 6 by 9 in.; pp. 8.

**Filters.**

BLAISDELL CO., Los Angeles.—Catalogue G illustrating and describing pressure filters. 6 by 9 in.; pp. 12.

**Gas Producers.**

FORTER-MILLER ENGINEERING CO., Pittsburg.—Catalogue treating of the Forter water sealed gas producer. Illustrated. 9 by 12 in.; pp. 62.

**Generator Valves.**

LUNKENHEIMER CO., Cincinnati.—Booklet, printed in two colors, illustrating and describing several types of generator valves designed to meet various requirements, together with a price list. 3½ by 6 in.; pp. 24.

**Heating Furnaces.**

ROCKWELL ENGINEERING CO., New York.—Pamphlet illustrating bolt and rod heating furnaces that may be operated with oil or gas fuel. 6 by 9 in.; pp. 8.

**Lathes.**

GISHOLT MACHINE CO., Madison, Wis.—Well-printed catalogue illustrating and describing turret lathes, boring mills and tool grinders. 8 by 10 in.; pp. 16.

**Machinists Tools.**

BROWN & SHARPE MFG. CO., Providence.—Catalogue containing an illustrated description, together with prices, of pocket scribers, spacing attachment, center punches, combination caliper and divider, micrometer caliper sets and steel rules with holders. 6 by 9 in.; pp. 8.

**Mechanical Draft.**

GREEN FUEL ECONOMIZER CO., Matteawan, N. Y.—Bulletin No. 108 containing an illustrated description of mechanical draft apparatus. 6 by 9 in.; pp. 16.

**Pipe Flanges.**

AMERICAN SPIRAL PIPE WORKS, Chicago.—Catalogue describing forged and rolled steel pipe flanges, special forgings, and full size cross sections of flanges used in the different standards. Also contains tables giving sizes, prices, etc. The catalogue is well printed and illustrated. 8 by 10½ in.; pp. 94.

**Pneumatic Hammers.**

INGERSOLL-RAND CO., New York.—Bulletin No. 2010 contains an illustrated description of pneumatic hammers. 6 by 9 in.; pp. 24.

**Oil Filters.**

STANDARD GAUGE MFG. CO., Syracuse.—Booklet illustrating and describing oil filters. Also contains tables giving dimensions, capacities, and prices. 6 by 3½ in.; pp. 12.

**Recording Voltmeters.**

BRISTOL COMPANY, Waterbury, Conn.—Bulletin No. 57 illustrating and describing recording voltmeters for use on either direct or alternating current regardless of the rate of alternations. 8 by 11 in.; pp. 4.

**Regulators.**

LOCKE REGULATOR CO., Salem, Mass.—Catalogue M illustrating and describing regulating devices for the conduct and control of steam and water pressure, together with price list. 6 by 9 in.; pp. 56.

**Sand Pump.**

J. H. FRENIER & SON, Rutland, Vt.—Catalogue illustrating and describing sand pumps for pump-

ing sand, crushed ore and pulp in wet state. 4½ by 8¼ in.; pp. 12.

**Scales.**

HOWE SCALE CO., Rutland, Vt. — Illustrated price list, pocket size, describing scales of many different styles. 4 by 6 in.; pp. 176.

**Skylights.**

THOS. W. IRWIN MFG. CO., Allegheny.—Catalogue illustrating and describing various styles of skylights, together with views showing buildings on which they have been used. 9 by 6 in.; pp. 24.

**Steam Engines.**

VALLEY IRON WORKS, Williamsport, Pa.—Bulletin illustrating and describing steam engines. 6 by 9 in.; pp. 24.

**Steam Hammers.**

CHAMBERSBURG ENGINEERING CO., Chambersburg, Pa.—Catalogue containing an illustrated description of steam hammers and hydraulic machinery. 6 by 9 in.; pp. 48.

**Steam Pumps.**

UNION STEAM PUMP CO., Battle Creek, Mich. —Booklet, pocket size, illustrating and describing steam and power pumps for all pumping duties. 4 by 5 in.; pp. 48.

**Steam Specialties.**

STRONG, CARLISLE & HAMMOND CO., Cleveland. Catalogue containing an illustrated description of steam traps, reducing valves, pump governors and feed water controllers. 6 by 9 in.; pp. 32.

KITTS MANUFACTURING CO., Oswego, N. Y.— Catalogue No. 3 describes steam traps, reducing valves, safety water columns, boiler feeders, pump governors, feed water regulators, and flue cleaners. Illustrated. 6½ by 6¼ in.; pp. 24.

**Transformers.**

MOLONEY ELECTRIC CO., St. Louis.—Well-printed catalogue illustrating and describing transformers. 6 by 9 in.; pp. 36.

**Valves.**

D. T. WILLIAMS VALVE CO., Cincinnati.—Illustrated catalogue and price-list for 1907 describing brass and iron valves, gauge-cocks, fittings, oil and grease cups, lubricators, steam traps, separators, etc., together with tables giving sizes. Also contains several pages of useful data. 5 by 7 in.; pp. 164.

# CLASSIFIED ADVERTISING SECTION

*Rate, three cents a word per month. Minimum charge $1.00 per month. No electrotypes or illustrations; no display type. Cash with order. Forms close 20th of the month preceding date of issue.*

*Box numbers may be used and we will forward all replies. We will not give information about any advertiser using a box number. Correspondents answering advertisements may specify that their replies shall not be forwarded to certain persons or firms—thus avoiding possible embarrassment. Original letters of reference, etc., should not be sent to unknown correspondents; copies will serve the same purpose.*

## HELP WANTED

SALESMEN: Technical trained men to sell machinery or kindred lines. Salary and commission; choice of desirable territory. Also good positions for Architects, Chemists, Draftsmen, Foremen, Superintendents and other high-grade technical men. HAPGOODS, 305 Broadway, N. Y. 12-6

## SITUATIONS WANTED

CHEMIST: Graduate, now at head of chemical and physical testing department mechanical engineering concern; desires position with metallurgical or chemical firm; four years' experience with iron, steel, copper, aluminum and ores; A-1 references; age 28; location, immaterial; salary $100. Address "RELIABLE," Room 322, Y. M. C. A. Bldg., Canton, Ohio. 1-8

OPEN FOR ENGAGEMENT, August 1, as manager or superintendent of mines, wide experience and successful nine years' experience in California and Central America; technical education; six years head of largest properties in Central America; Spanish spoken and written; best of references. Address A. M. YONGE, Amador City, California. 2-8

ADVERTISING WRITER, with ability to write strong business getting copy and qualified to manage your advertising department, desires to connect with some good house; if your business is not large enough to warrant an advertising manager let me make you a proposition to handle what advertising literature you may need; I will act as your advertising adviser at a small amount each week. BOX 104, THE ENGINEERING MAGAZINE, 140 Nassau Street, New York.

## ADDING MACHINE CARRIAGES

DOUBLE THE VALUE of your adding machine by installing the Eureka Adding Machine Carriage. The only practical and durable device for adding machines. Protects the machine and adds to the comfort and convenience of the operator. Write to-day for illustrated catalogue containing full particulars. EUREKA ADDING MACHINE CARRIAGE CO., 52-54 Winder Street, Detroit, Mich. 4-9

## ADVERTISING NOVELTIES

We want every advertising manager in America to know us and we want to know every advertising manager. On receipt of request we will send you with our compliments a handsome souvenir. S. D. CHILDS & COMPANY, MAKERS OF ARTISTIC NOVELTIES IN METAL FOR ADVERTISERS, 200 Clark Street, Chicago. 6-11

### AUTOMOBILES

"SUCCESS" AUTOMOBILE $250. The original motor-buggy. After eleven years labor by an engineer a perfect steel tired Auto. Runs 25 miles an hour, good hill climber. Write for particulars. SUCCESS AUTO-BUGGY MFG. CO., Inc., 532 De Baliviere Avenue, St. Louis, Mo. 12-6

### BILL BINDER AND LOOSE LEAF HOLDER

THE KLIP BILL BINDER AND LOOSE LEAF HOLDER. No holes to punch. Instantly removable. Covers to order. Price list FREE. Sample dozen mailed for 75 cents. H. H. BALLARD, 150 Pittsfield, Mass. 5-11

### BOOKS.

ADVICE: Mechanical, practical, technical. Expert in shop practice, sheet metal formation, processes, machines, practice in steel treatment, manufacture of interchangeable machine parts and metal articles. My books are authorities. Postal brings printed matter and references. JOSEPH V. WOODWORTH, M.E., Arbuckle Building, Brooklyn, New York. 12-6

THE FACTORY MANAGER tells how to eliminate dead expense; unnecessary fixed charges; friction and delays; useless men, methods and records; unnecessary time and material; interruptions, "waits," and guess-work; too many handlings of work, etc., and how to arrive at exact cost of work done. Send for circular. THE ENGINEERING MAGAZINE, 140-142 Nassau Street, New York.

THE ENGINEERING INDEX ANNUAL for 1906 embraces all branches of engineering, and clearly indexes alphabetically by subject about 7,000 important articles of permanent value which appeared during 1905 in about 250 engineering journals, transactions and proceedings. Complete in itself for the period covered. We undertake to supply the full text of every article indexed in the original language, together with all accompanying illustrations. 416 pages, 9½ by 7 inches, cloth binding; $2.00 prepaid. Sent on approval. THE ENGINEERING MAGAZINE, 140-142 Nassau Street, New York.

### CARBON PAPER AND RIBBONS

WHITFIELD'S carbon papers are the non-smutty kind. Guaranteed to keep in any climate. Colors, black, blue, purple, green or red, at 50c. a book of 25 sheets, for either pen, pencil or typewriter. Liberal terms to agents. WHITFIELD CARBON PAPER WORKS, 123 Liberty Street, New York. 6-12

CARBON PAPER IN ROLLS is the new money saving idea on high grade carbon paper. Tear off the exact length desired, no more. Absolutely no waste. We send the cases free, and supply you with fresh rolls, as needed. Costs no more than ordinary carbon paper. Saves one-third. Send for details regarding our special introductory plan to-day. TYPO-CARBON CO., Sheboygan, Wis. 3-8

CARBON PAPER. We are changing the formula for making our black carbon paper, and while the balance of our present stock lasts it goes at $1.00 per box, 8½ by 11 or 8 by 13, black only. Delivered free to any address in the United States. Money refunded if not found satisfactory. CLARK & ZUGALLA, Paper Makers, Manufacturers of Carbon Papers, Typewriter Ribbons and Office Supplies, 98 Gold St., New York. 3-8

CARBON PAPER. Our non-smut carbon paper has many advantages. It absolutely will not soil the hands, which grease carbon does. It thereby acts as a time-saver, eliminating the continual washing of hands. Wears longer—does better work and is considerably cheaper. We also manufacture ribbons of all colors for all machines. Send today for samples and prices of our carbon paper. FIDELITY CARBON PAPER CO., 101 Tremont Street, Boston, Mass. 3-8

### COPYHOLDERS

"RIGHT-IN-SIGHT" COPYHOLDERS have a joint arm as flexible and universally adjustable as the human arm. You can use them with any make of typewriter or adding machine. Send to-day for further information. COMBINED TOOL CO., Leominster, Mass. Agents Wanted. 6-11

### DUPLICATORS

MULTICOPYING BY THE BENSINGER "RAPID" DUPLICATOR is quicker, more satisfactory and cheaper than by any other device, when numerous copies of any writing are desired. It will pay you to hear of our proposition, write to-day. C. G. BENSINGER CO., 34 Stone Street, New York. 3-8

THE LINEOGRAPH rotary or flat duplicator makes 1,000 perfect copies, costs 100 per cent. less than similar duplicators, and has no license restrictions. Don't buy any duplicator until you have seen the Lineograph. Write to-day for circular. THE LINEOGRAPH CO., 112 Fulton Street, New York. 4-9

### EXPORTERS.

WE EXPORT COMPLETE LINES of goods for mill and factory equipment. We reach over 25,000 buyers and consumers abroad, all interested in mechanical lines. We quote delivered prices (C. I. F.) on all goods, and are the only export machinery merchants doing this for all ports. We keep manufacturers' catalogues and our prices regularly filed and up-to-date with over 500 merchants throughout the world. We bring the orders back beside advertising your products. THE C. I. F. COMPANY, 32 Broadway, New York City, U. S. A. 3-8

### HYDRAULIC ACCUMULATOR—FOR SALE

HYDRAULIC ACCUMULATOR For Sale. Measurement 36-7-72, water weighed, running pressure 1,500 lbs. to the square inch, never used —just as come from manufacturer. Write Winslow Bros. & Smith Co., Norwood, Mass. 2-9

### PATENTS

I SELL PATENTS. To buy or having one to sell write CHAS. A. SCOTT, 1020 Granite Bldg., Rochester, N. Y. 6-11

### PNEUMATIC TUBES.

PNEUMATIC TUBES, electrically controlled, are an ideal service for communication between departments, for distribution of mail, orders, etc. We make a specialty of systems for underground or interior service for offices, banks, factories, manufacturing plants, etc. Power used only while carriers are in transit. Plans and estimates furnished. ELECTRO PNEUMATIC TUBE CO., Times Building, New York. 3-8

### TYPEWRITER PAPERS.

ALMOST ANY BUSINESS MAN would be interested in our Specimen Book of papers for office use. A request on your stationery brings it. CLARK & ZUGALLA, Paper Makers, 98 Gold Street, New York. 3-8

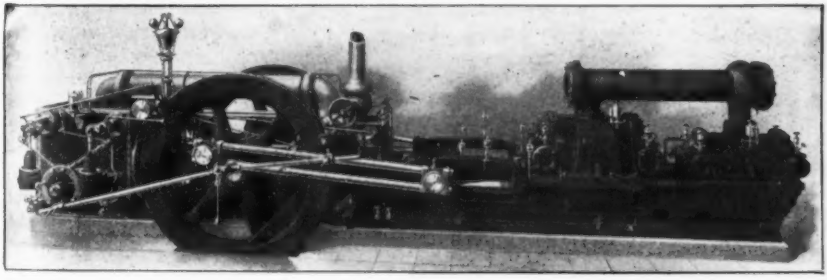
# IMPROVED MACHINERY

## New Processes and Appliances

*The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.*

### A Straight Line Corliss Air Compressor.

ENGINEERS recognize in the Corliss engine the most economical means of compressing air by steam power. In the cross-compound type one horse power may be produced on from 14 to 16 pounds of feed water per hour when running condensing, or 20 to 23 pounds non-condensing. But the price of the Corliss unit appears large to many operators, even in regions where the cost of the fuel saved would pay for the entire machine in a short time. Slide valve compressors are, therefore, often installed. The development of an air compressor combining high steam economy with moderate price has advanced but slowly. In some cases the principles of good mechanics have been distorted to the sacrifice of durability, ease of action and mechanical efficiency, in order to reduce construction costs; in other words, various substitutes for the full Corliss valve gear have been offered. It is conceded that some of these compromise machines may fairly claim a certain degree of economy in operation, and that when a test is made under ideal running conditions they make a good showing as compared with a Corliss compressor. The conditions of every-day operation, however, are not once in a hundred like those prevailing in a test. In one case the steam pressure, air pressure and speed are all constant, while in the other the fluctuation in any or all of these factors is likely to be extreme. Sometimes these extremes oppose one another, or they may be high or low together. It is on account of this fluctuation that the Corliss compressor uses so much less coal in the course of a day's run. Its valve gear brings the cut-off in the high and low pressure steam cylinders under the automatic regulation of the governor. There is no wire-drawing of the steam, nor is there throttling action at any time.



A compressor has been designed by S. T. Nelson, mechanical engineer with the Sullivan Machinery Company, which embodies the economy of the Corliss cross-compound type in a form which permits moderate price without the sacrifice of good engineering. The new machine, known as the "Class WO," is described as a "tandem compound steam, two-stage air, Corliss straight line compressor." To put it differently, tandem compound steam cylinders with full Corliss valve gear on both have been attached to the fly-wheel end of the standard Sullivan two-stage straight-line compressor, the high pressure steam cylinder occupying the same position as the single Meyer valve cylinder of the "WB-2" machine. The high pressure steam cylin-

der is of special design, to make room for the Corliss valve bonnets and dash pots between the cylinder and fly-wheels, and to do this the steam chest is offset to one side. The dash pots for closing the steam valves are set directly on the main frame and the motion rods for operating the exhaust valves are arranged in the usual way, except that they are longer. Back bonnets are provided as usual, and the frame is so designed that either one or all of the steam or exhaust valves may be removed without disturbing the valve setting. The low pressure steam cylinder is attached to the end of the frame by means of rigid distance pieces. The bottom feet of this cylinder are on the same level with the bottom of the main frame and its weight is supported by an extension of the foundation. Practically the same pattern is used for making this cylinder that is used for the Sullivan cross-compound Corliss machines. It embraces all of the regular valve gear usually furnished with the latter type of machine.

There are no adjustments between the fly-wheels and the steam cylinders to require attention while the compressor is in operation. The piston rod stuffing boxes are packed with fibrous metallic packing, which needs only occasional care. The main bearings and other parts which cannot be oiled by hand running, are lubricated by a system of pipes leading from a cluster of oilers mounted at a convenient point, so that the engineer can tell at a glance when one of them is empty. The eccentrics for operating the valve gear on both the high pressure and low pressure steam cylinders are placed on the crank pin on the outside of the fly-wheels, so that they are easily accessible. The eccentrics, rocker arms, valve stems and all connections between the fly-wheels or between the main bearings on the "WB-2" type are dispensed with in the "Class WO." The governor pulley is all that is placed on the shaft in their place. The removal of these parts allows the use of two piston rods between the high and low pressure steam cylinders, which are necessary to straddle the crank shaft, which is kept in its original position in line with the cylinders. The governor is on a separate mounting and is a combined speed and pressure regulator. In appearance, it is of the Corliss fly-ball type, but it is operated in unison with the pressure attachment. The exhaust steam from the high pressure cylinder is carried around the outside of the cylinder barrel to the top by a passage cast with the cylinder, and discharges into a covered receiver pipe extending from the top of the high pressure to the top of the low pressure cylinder.

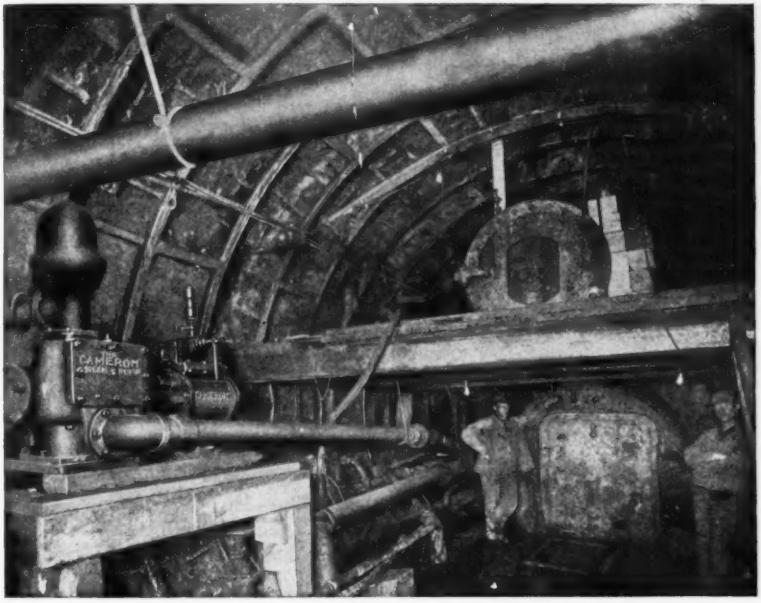
From the standpoint of air efficiency this compressor takes the high rank of the class WB-2 machine. The inlet valves on both low and high pressure cylinders are of the semi-rotary pattern, positively driven by motion rods from an eccentric pin on the engine fly-wheel. The action of these valves permits the cylinder to fill itself completely at each stroke with air at the temperature of the atmosphere, and there is no wire-drawing or leakage. The discharge valves are of the automatic poppet type, so arranged as to reduce clearance losses to a minimum. The valves and their seats are removable by hand, so that the maintenance of a perfect fit is a simple matter. The ideal of isothermal compression is approximated in these machines by means of unusually adequate cooling apparatus. This consists of heavy water-jackets on the air cylinders, and an inter-cooler of ample proportions, containing copper water tubes, across which the air must pass several times in its course from the intake to the discharge cylinder.

The "Class WC" compressor is built very substantially, being self-contained on its heavy frame and on the distance pieces connecting the two steam cylinders. These parts are sufficiently massive to sustain the low pressure cylinder of themselves, without the aid of foundations if such a necessity should arise. The straight-line type unites with its advantages of engineering excellence, the features of low weight, simplicity, and minimum foundations, as compared with duplex machnes. These qualities render it possible to sell these compressors at a comparatively low price, to transport them readily and at small expense, and to erect them without elaborate and costly preparations at the desired site. They are built at present in sizes ranging from 909 to 2,450 cubic feet of free air per minute.

**The Belmont Tunnel.**

RAPID progress has been made on the Belmont tunnel now being constructed under the East River, New York. This tunnel and subway is more than three miles in length, extending from Park Avenue and Forty-second Street, Manhattan, to Jackson Avenue and Fourth Street, Long Island City, and will afford easy and quick transit between the boroughs of Queens and Manhattan, connecting with the Interborough system of subways, near the Grand Central Station.

tion Company are the builders of this tunnel, and have a complete equipment for handling the work and are using the most modern methods. There are five shafts or entrances to the tunnel: two on the Manhattan side, two on the Long Island City side, and a shaft in the centre of the East River on Man-o'-War Reef. The latter is on a coffer-dam built in the river by the contractors with the Government's permission. Parts of the tubes were driven by the single bench method under atmospheric pressure; but under the river bed the shield

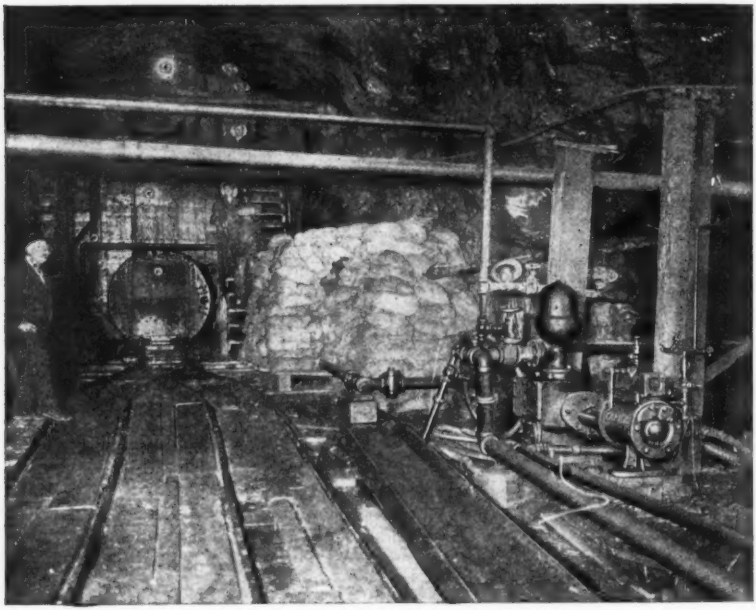



The first shaft was started July, 1905, and the work has been rushed night and day ever since, and it is expected that both tubes will be completed and in full operation the latter part of this year. This tunnel consists of two parallel tubes, each arranged for single tracks. Parts of the tubes are horse-shoe shaped, while under the river bed they are circular and built of sectional cast-iron rings, all substantially made and safe to a degree far in excess of what is required to carry the heavy electric trains.

The Degnon Engineering and Construc-

method was substituted and the subaqueous tubes were continued by the shields, cutting their way forward and pushed by the hydraulic jacks operated by compressed air. The shields are 15½ feet in diameter, the exact size of the cast-iron shells which are set in place and bolted together. Compartments or airlocks are formed between the shields and the finished tunnel by steel bulk heads, and the pneumatic pressure, which is maintained equal to the hydrostatic pressure at the center line of the tubes, holds up the river bed and prevents the water from drowning out the workings. There

is, however, an accumulation of water coming into the workings from the bottom of the tubes where the "sandhogs," so-called, are at work, and where the hydrostatic pressure is greater than the pneumatic pressure. The water is collected in temporary sumps constructed in the air-locks, and from there is forced out by the air pressure through the pipes to the various pumping stations that are situated along the line of construction. This method readily takes care of the water from the air-locks, but there is a constant seeping through joints where the calking has not been completed, as well as an accumulation of drainage water coming into the tubes.



In several places the segments or wall plates have been removed and the rock and other material forming part of the 8 feet of partition between the two tubes were cut through to provide for the sump chambers and allowing room for the pumping stations. Where the pumps are situated alongside the tunnel walls and in the workings, no extra room was required for their installation, as they are all of the Cameron design, having the Cameron characteristic of compactness. Engineers have taken advantage of this type of pump for underground construction work on account of its having no outside valve gear and its entire absence of moving arms or levers to become broken or get out of alignment. These pumps are massive in construction to prevent injury from blasting, falling rock, and débris. They can be relied upon in case of sudden flooding into the excavation and caisson linings, and will work as well under water as above. In emergencies or accidents the normal capacity can be doubled, as occasionally occurs when they are run at a piston speed of over 200 feet per minute. A unique and simple device is attached to the pumps to keep the exhaust compressed air from freezing in the air cylinders. A small pipe is connected from the discharge water pipe to the exhaust openings on the air cylinder over which the spray from a ⅜-in. nozzle flows constantly while the pump is running; thus equalizing the temperature about the exhaust chamber and preventing freezing. This simple device also acts as a muffler

on the exhaust, which would otherwise be deafening to the workers in these closed tubes.

### Insurance Against Loss of Profits.

PROBABLY every reader of this magazine is familiar with fly-wheel insurance, which is similar to steam boiler insurance and covers the loss and damage resulting from the bursting or disruption of a fly-wheel. Not the least valuable feature of fly-wheel insurance is the inspection service which insurance companies furnish as a part of their policy. Many serious defects in the fly-wheel or engine are found, the timely correction of which by insurance company inspectors has prevented serious loss. In spite of the most careful inspection, however, fly-wheel accidents are of frequent occurrence, and when one does occur the property loss is usually very large. Another feature, however, which has heretofore been overlooked by insurance companies, is the loss of profits which results to the manufacturer from his inability to produce goods after his plant has been demolished by an exploding fly-wheel. Machinery cannot be replaced quickly. As a matter of fact it usually takes months to replace the mechanical equipment of a plant. When the machinery is of a special type or designed for a special purpose the delay, of course, would be much greater. This condition of affairs has caused the Maryland Casualty Company of Baltimore, Md., to issue what they call the "Use and Occupancy Endorsements," to be attached to their fly-wheel insurance policies. This endorsement provides for the payment of a specified indemnity during the inability of the plant to manufacture goods. The exact amount is arranged for in advance, and is based upon the average production of the plant during the three hundred days preceding. A noticeable feature of this endorsement is that the portion of the insurance applicable to the loss of profits indemnity is not deducted from the face value of the policy, but is a separate insurance, which the company pays in addition to the face value of the policy. We understand that there has been a great demand for this protection. The Maryland Casualty Company will be glad to furnish full information upon application.

### Concrete Ash Bins.

THE accompanying cuts illustrate a reinforced-concrete ash bin and elevator, which were recently installed by The Jeffrey Manufacturing Company of Columbus, Ohio, at the power plant of the Knoxville Railway and Light Company, at Knoxville, Tenn., for handling the accumulation of ashes at their power plant. At this plant the ashes are handled in small push carts from boiler house to elevator, where they

are dumped into a receiving hopper and elevated by means of an elevator of the chain and bucket type to a bin. This bin holds approximately 30 tons of ashes, and delivers its contents to railroad cars on a switch running alongside of the bin, through the bin gates and aprons. The elevator, which is 46 ft. centers, has a capacity of 12 tons per hour, and is operated by a 5 horse power motor connected to the head shaft of the elevator. The elevator being encased the entire length and delivering through a steel spout to the bin makes the equipment practically dust tight. Anyone interested in this class of equipment may receive full information concerning it by writing direct to the Jeffrey Manufacturing Company, Columbus, Ohio.

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**Universal Index and Spiral Head.**

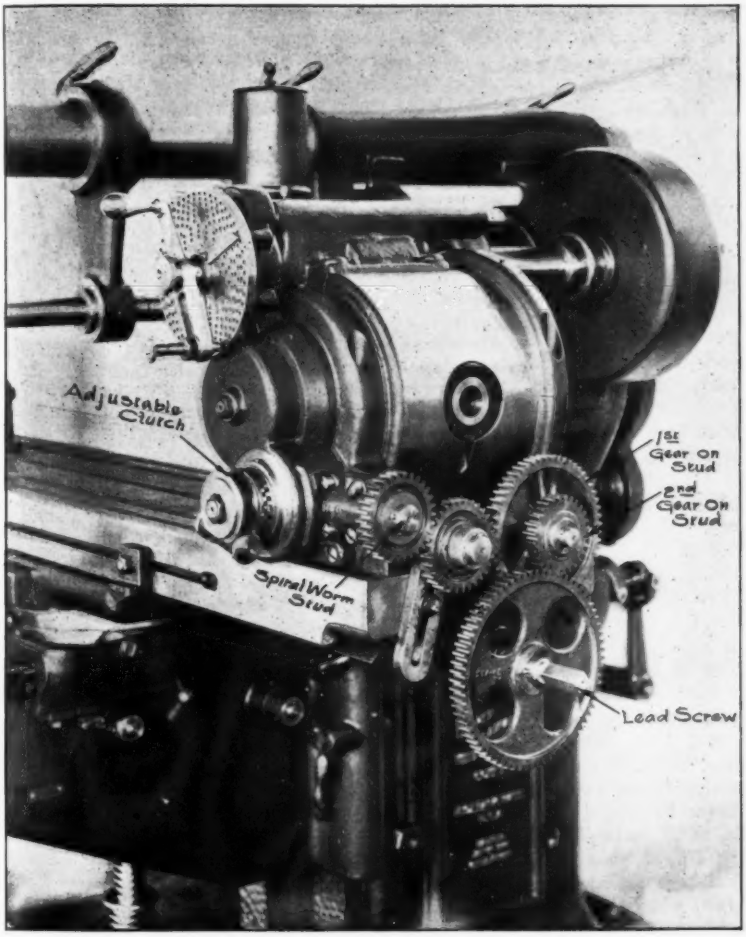
BECKER-BRAINARD Milling Machine Company, Hyde Park, Mass., have brought out a new universal index and spiral head. The points of special interest in this new head are its stiff and rigid construction; its large worm and worm wheel of coarse pitch; arrangement by which differential indexing may be accomplished regardless of the head's position on the machine platen; arrangement by which differential indexing may be accomplished on other than plain cylindrical work, such as bevel gears; arrangement by which differential indexing may be accomplished on work with helical grooves, such as spiral gears; arrangement by which the spindle and work may be rotated independent of the lead screw when the change gears are set for spiral milling; making the setting of the work much easier than it would otherwise be; the adjustable clutch for facilitating the last operation; the index crank with handle for rotating the same separate from the index pin, giving a crank of the same throw regardless of the position of the index pin and eliminating the danger of the pin dropping on the plate while revolving the crank; the single reversible index plate for all divisions; adjustable dial on the spindle nose for obtaining angular division in degrees for work requiring no great accuracy; means for taking up wear in worm gear or dividing wheel.

This head is the result of a desire to fill the need of a spiral head that will at once answer the requirements of the heavier duty now imposed on the milling machine and still retain the fine points of accuracy expected from such a tool. In designing this head it has been the object to produce a design that would answer the requirements of the wide range of work met with in ordinary practice without sacrificing any of the desirable features of the older heads, and to add those features that good practice shows would greatly increase the usefulness of the head on general work. The worm gear is made in two sections so that one section may be rotated on the other to take up the wear on the teeth. This method has long been used and is the most accurate method of adjusting for wear and also in the hobbing of the teeth in the blank. The stiffness and rigidity of the construction is shown plainly in the view. This increase in strength has in no way impaired the ease of handling nor made the head at all clumsy or awkward to operate. The design is of an approved type, having the swivel block housed between heavy uprights in which the block swings in a vertical plane. The block is held in any position by means of clamping bolts which draw the outside plates securely against the uprights, making a secure bind holding the head in position against the heaviest cuts.

The principal feature of the design is the large worm wheel that has been obtained. This gear has been made as large as the respective swing of each size head would allow, and by the design followed it has been made much larger than that of any head so far offered. This large diameter adds much to the life of the wheel and insures greater accuracy in the work than would be possible with the smaller diameter common to other dividing heads. The large diameter and resulting coarse pitch allows of much heavier spiral cuts being taken without the danger of impairing the accuracy or of distorting the teeth in the gear. The increase in stiffness of the head in general makes possible the taking of much heavier cuts at faster feeds and speeds, obtaining the best possible results with high speed steels.

In bringing out this new head the idea of making the differential indexing mechanism a component part of the head has

been carried out so that the head may be used as an index or dividing head in any position along the platen with the spindle either parallel with or at right angles to the main spindle of the machine, or in any intermediate position. This has been accomplished by placing the change gears used in differential indexing on the rear side of the head. The gears have no connection with the table at all as is the case with the ordinary index head fitted for differential indexing. With the gears used in differential indexing arranged on the head, as is done on this head, it is possible to swing the spindle into position for cutting bevel gears or teeth on any conical work. This at once broadens the scope of differential indexing from straight cylindrical work to that which requires the angular setting of the spindle in the vertical plane. In order that the application of the differential indexing may be universal, it is necessary that it be made available for use on work with helical or spiral grooves, such as spiral gears. It has been done in this new head.



# NEWS SUPPLEMENT

The Engineering Magazine—September, 1907

### Personals.

—J. Cecil Nuckols, for the past three years advertising manager of The S. Obermayer Co., Cincinnati, has recently received the additional appointment of advertising manager of The Cincinnati Electrical Tool Co.

—Mr. John C. Ostrup, M. Am. Soc. C. E., has been appointed to fill the Chair of Structural Engineering at the Stevens Institute of Technology, Hoboken, N. J.

### Industrial Notes.

—Sullivan Machinery Co., Chicago, announce that their San Francisco branch is now located at 26-28 Fremont St. Howard T. Walsh, manager.

—Atlas Engine Works, Indianapolis, announce the appointment of Otto Dieckman, Jr., as manager of their direct sales office at St. Louis, with offices in the Chemical Building.

—The E. H. Mumford Co., Philadelphia, has assumed exclusive sales agency for the new French molding machines of Ph. Bonvillian & E. Ronceray, also of Philadelphia.

—Colné & Co., successors to Powell & Colné, New York, have just closed a contract with the Government for the installation of a steel casting equipment by the Tropenas converter steel process at the Mare Island Navy Yard, California.

—Parker Boiler Co., Philadelphia, report the following orders: Austin Mfg. Co., Harvey, Ill.,, 1 365 H.P. boiler; Southern Indiana Hospital for Insane, Evansville, Ind., 3 300 H.P. boilers; Perth Amboy Chemical Co., Perth Amboy, N. J., 1 267 H.P. boiler.

—The American Consul at Kingston, Jamaica, announces that he is installing a Catalogue and Reading Room, in which he will systematically arrange catalogues of American advertisers, trade journals, magazines, etc., and that he would be pleased to receive copies of catalogues issued by American manufacturers.

—"The Art of Cutting Metals" by Frederick W. Taylor, M.E., Sc.D., which was the Presidential address presented at the last annual meeting of the American Society of Mechanical Engineers, has been reprinted and bound in cloth by the Society. This or any other publication of the Society may be had by addressing the Secretary, 29 West 39th Street, New York.

—One of the most complete and modern lines of brass and iron specialties is shown in the catalog of The Wm. Powell Co., Cincinnati. This catalog presents their line in a most complete and practical manner, giving dimensions of every article for which a dimension may be required, and explaining in detail the merits of their well-known specialties. A valuable series of tables and rules is bound in with the catalog, giving in a concise form information that every engineer and shop manager requires in his daily practice. A copy will be sent free to interested parties.

—The Vredenburg Co., with an office at 1332 Monadnock Block, Chicago, is devoted to a consulting practice in engineering and general technical advertising, being the only concern of the kind in the West. This company is prepared to render careful and expert service to engineering, contracting and manufacturing companies, desiring intensification of their advertising, the changing of copy weekly, bi-weekly and monthly, and the preparation of dignified, attractive advertisements. The manager, Clarence Vredenburg, was editor and manager of *Engineering World* from its inception until its recent sale.

—The Isthmian Canal Commission has decided that the walls of the canal, where it passes through rock, shall be channeled. This includes almost all of the "wet prism" in the Culebra Division, nine miles long, and also the walls of the locks at La Boca and Mira Flores. The advantages to be

gained from channeling are several. (1) The resulting wall is solid and unbroken by explosives. (2) The wall is cut exactly to the surveyed line—no subsequent trimming or filling is needed, as in the case of a wall cut by drilling and blasting. For this work the Commission has ordered from the Sullivan Machinery Co., Chicago, 24 class Y-8 channelers, fitted with air reheaters.

—The valuable results obtained by the United States Geological Survey at the St. Louis Exposition in determining the actual steam-making values of American fuels is to be continued with a similar plant at the Jamestown Exposition. The report on the St. Louis tests is devoted largely to fuels from the Middle West and Western coal fields. The plant now being erected at Jamestown will give an opportunity for analyzing, testing and placing on record in a similarly thorough and comprehensive manner the coals from the Eastern fields. The Jamestown plant will obtain three 300 H.P. boilers, each equipped with an engine-driven 100-inch mechanical draft fan and a 35-ft. stack both supplied by the Green Fuel Economizer Co., of Matteawan, N. Y. The fans will be so controlled that the draft can be regulated as desired by hand or automatically. The wheels of the fans measure 5 ft. in diameter by 2⅔ ft. width at the tips of the blades and are driven by 6 × 7-inch Green vertical center crank engines. The laying out of the mechanical draft plant was entrusted by the Survey to the Green Fuel Economizer Company.

—The Power Specialty Co., New York, announce the appearance of the fourth edition of its pamphlet on Superheated Steam, which has been revised by E. H. Foster, the inventor of the Foster superheater. This edition contains illustrations of superheaters manufactured by the company as applied to the various types of boilers in use in this country, and also of the direct fired type, ranging from large illustrations of 3,000 H.P. units to small portable superheaters, which may be used for experimental purposes. The pamphlet also contains reproductions of photographs of various parts showing the construction of the Foster superheater in detail, and a few pages are devoted to superheated steam specialties, such as piston rod packing, Harter flexible joints, corrugated bronze gaskets, and the Willits double acting non-return valve, all of which articles are sold by the company as being especially adapted to plants having superheated steam. At the back of the book are steam tables running to high pressures and temperatures, and tables of velocities of steam in various sizes of pipe at different degrees of superheat, and curves for readily selecting the proper size of steam pipe for any set of conditions, which will be found most useful to the designing engineer.

The introduction of the electric motor into modern methods of manufacturing has practically revolutionized many of our industries. The variety of uses to which the motor has already been put is one of the wonderful features of the present day's industrial operations, and yet its development appears to have only just begun. The absence of steam, dirt and smoke, the extensive elimination of the dangerous belt, as well as the greater economy of electric power over steam, are some of the causes which are making the ascendency of the "electric drive" so phenomenally rapid. So important has this work become that the larger electric companies have a special department, which takes care of the work of electric motor power production. Taking, for example, some of the orders which the Westinghouse people have taken in this field since the first of June, the variety of the use of the motor becomes evident. The East Pittsburg works are now turning out sixteen locomotives for coal mines in West Virginia and Kentucky, one for an iron mine in Sweden, another for a power company in the State of Washington, and one for a plate glass mill at Charleroi, Pa. They are constructing a complete electric motor equipment for a phosphate mine in Florida, for a lumber camp at Mount Pleasant, Pa.; they have in hand an order for 39 motors to drive machinery in a cash register manufacturing plant at Dayton, O.; they are turning out 59 motors for driving textile looms at East Hampton, Mass., and a larger number for running spindles in a worsted mill at Passaic, N. J. Fifteen motors are going to a paper mill in Canton, N. C., and twenty to a paper mill in Fulton, N. Y.

# NEW CATALOGUES AND TRADE PUBLICATIONS

*NOTE—The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index. See page 11.*

**Adding Machine Carriage.**

EUREKA ADDING MACHINE CARRIAGE CO., Detroit.—Leaflet containing a brief illustrated description of adding machine carriages, together with a list of recent purchasers. 6 by 9 in.; pp. 6.

**Ball Bearings.**

BANTAM ANTI-FRICTION CO., Bantam, Conn.—Catalogue illustrating and describing ball and roller bearings of all types. 6 by 9 in.; pp. 46.

**Blue Printing Machines.**

BUCKEYE ENGINE CO., Salem, Ohio.—Booklet containing a copy of a speech on The A B C of Blue Printing delivered by Prof. A. C. Tinic before The National Federation of Blue Printers. 4¼ by 6½ in.; pp. 20.

**Bronze Bearings.**

LUMEN BEARING CO., Buffalo.—Well-printed and illustrated catalogue treating of the numerous uses to which Lumen bronze bearings may be adapted. 6 by 9 in.; pp. 32.

**Coal Puncher.**

THE PNEUMELECTRIC MACHINE CO., Syracuse.—Well-printed catalogue illustrating and describing an electric coal puncher. 7½ by 9½ in.; pp. 24.

**Coal Storage.**

DODGE COAL STORAGE CO., Philadelphia.—Catalogue No. 70 contains illustrations showing some recent installations for the handling and storing of coal and ore, together with brief descriptions of each. 6 by 9 in.; pp. 112.

**Concrete Bridges.**

NATIONAL BRIDGE CO., Indianapolis.—Well-printed catalogue illustrating and describing some of the reinforced concrete bridges recently erected by this company. 6 by 9 in.; pp. 96.

**Concrete Machinery.**

MCKELVEY MACHINERY CO., Cleveland.—Catalogue containing an illustrated description of batch concrete mixers, continuous and hand power mixers, concrete buckets, contractors' machinery, industrial cars, etc., together with tables giving capacities per hour. 9 by 6 in.; pp. 40.

**Concrete Piles.**

SIMPLEX CONCRETE PILING CO., Tacony, Philadelphia.—Catalogue containing an illustrated description of concrete piles for foundations, wharves, trestles, reservoirs, etc. 6 by 9 in.; pp. 86.

**Drafting Room Furniture.**

FRITZ & GOELDEL MFG. CO., Grand Rapids, Mich.—Catalogue and price list illustrating and describing drafting tables, drawing and training school tables and drafting room and office furniture. 7 by 5 in.; pp. 32.

**Electric Hoists.**

GENERAL ELECTRIC CO., Schenectady, N. Y.—Bulletin No. 4518 illustrates and describes the numerous applications of electric hoisting machinery and gives an outline of the work they are now doing in this field. Bulletin No. 4504 is devoted to an illustrated description of the G. E. Tungsten lamp for street series lighting and outlines briefly its importance to the central station.

**Electric Pyrometers.**

WM. H. BRISTOL, New York.—Catalogue No. 17 contains an illustrated description and classified price lists of different classes and styles of low resistance pyrometers, both for indicating and recording all ranges of temperature up to 3,000° F. 9 by 12 in.; pp. 42.

**Emery Wheels.**

STAR CORUNDUM WHEEL CO., LTD., Detroit.—Illustrated catalogue describing emery and corundum wheels, grinding machinery and sharpening devices, together with price list. 6 by 9 in.; pp. 102.

**Feed Water Filter.**

JAMES BEGGS & CO., New York.—Catalogue describing the Blackburn-Smith feed water filter and grease extractor for the removal of organic matter, sediment, lubricating oils, etc., from boiler feed water. Illustrated. 6 by 9 in.; pp. 16.

**Fire Brick.**

GARDEN CITY SAND CO., Chicago.—Well-printed booklet describing fire brick. Illustrated. Also contains special information on fire brick for specifications. 4½ by 7 in.; pp. 28.

**Furnace Grates.**

KELLY FOUNDRY & MACHINE CO., Goshen, Ind.—Catalogue K contains a brief illustrated description of dumping, rocking and stationary furnace grates. 9 by 6 in.; pp. 20. Catalogue F treats of boiler fronts. Also contains tables giving dimensions, weights and prices. 4½ by 7 in.; pp. 52.

**Furnaces.**

HAWLEY DOWN DRAFT FURNACE CO., Chicago.—Catalogue devoted to an illustrated description of the Hawley Down Draft Furnace. Also gives the results of many tests made. 10 by 7 in.; pp. 16.

**Gas Engines.**

ABENAQUE MACHINE WORKS, Westminster Station, Vt.—Catalogue containing an illustrated description, together with numerous testimonial letters. 9 by 6 in.; pp. 20.

**Gold Dredges.**

NEW YORK ENGINEERING CO., New York.—Pamphlet containing a treatise on dredges and gold dredging. Illustrated. 6 by 9 in.; pp. 20.

**Grindings Wheels.**

NORTON COMPANY, Worcester, Mass. — Well-printed catalogue illustrating and describing grinding wheels made of alundum and grinding machinery, together with price list. 6 by 9 in.; pp. 146.

**Hoisting Engines.**

JOHN F. BYERS MACHINE CO., Ravenna, Ohio.—Catalogue describing portable and semi-portable steam hoisting engines. Illustrated. 9 by 11 in.; pp. 78.

**Incandescent Lamps.**

WESTINGHOUSE LAMP CO., New York.—Catalogue giving a brief illustrated desciption of incandescent lamps for all purposes. 5 by 7¼ in.; pp. 38.

**Locomotives.**

BALDWIN LOCOMOTIVE WORKS, Philadelphia.—Pamphlet giving an illustrated description of balanced compound locomotives. 9 by 6 in.; pp. 32.

AMERICAN LOCOMOTIVE CO., New York.—Catalogue devoted to an illustrated description of 6-wheel switching locomotives and gives the principal dimensions of 26 different designs of this type. 9 by 6 in.; pp. 62. Also a pamphlet treating of 8-wheel type passenger locomotives. 9 by 6 in.; pp. 60.

**Mining Hoists.**

SULLIVAN MACHINERY CO., Chicago.—Well-printed catalogue containing an illustrated description of heavy duty mining hoists. Also contains views showing many recent installations. 6 by 9 in.; pp. 24.

**Pumping Machinery.**

RUMSEY & CO., Seneca Falls, N. Y.—Cloth bound illustrated catalogue describing hand and power pumps and hydraulic and pumping machinery for all purposes, together with tables giving capacities, prices, etc. 6 by 9 in.; pp. 256.

BUFFALO STEAM PUMP CO., Buffalo.—Catalogue No. 187 illustrates and describes pumping for every service. Section 1 is devoted to steam and power pumps and Section 2 to centrifugal and turbine pumps. Also contains tables giving dimensions, capacities and prices. 6 by 9 in.; pp. 132.

**Reducing Valves.**

MASON REGULATOR CO., Boston.—Catalogue, pocket size, giving a general illustrated description of bronze reducing valves and steam regulating devices, together with price list. 4 by 6 in.; pp. 80.

**Reinforced Concrete.**

STANDARD CONCRETE-STEEL CO., New York.—Well-printed catalogue illustrating and describing modern reinforced concrete buildings and the Guy B. Waite systems of fireproof construction. Also contains views of buildings recently erected. 8 by 11 in.; pp. 64.

# CLASSIFIED ADVERTISING SECTION

*Rate, three cents a word per month. Minimum charge $1.00 per month. No electrotypes or illustrations; no display type. Cash with order. Forms close 20th of the month preceding date of issue.*

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**THE VALUE AND ECONOMIC EFFECT OF RAILROAD IMPROVEMENTS—**
An Examination of Money Earnings from Increased Train Loads — Morrell W. Gaines — 849

**AMERICAN TRADE OPPORTUNITIES AND HANDICAPS IN SOUTH AMERICA—**
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**THE DESIGN AND CONSTRUCTION OF INDUSTRIAL BUILDINGS—**
Materials and Methods under the Most Recent Practice — D. C. Newman Collins — 906

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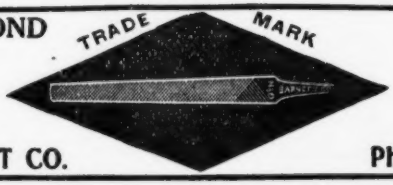


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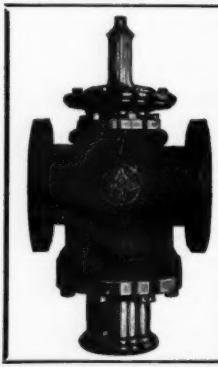

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## AUTHORS AND PAPERS FOR SEPTEMBER, 1907

MORRELL W. GAINES (*The Value and Economic Effect of Railway Improvements*)—Graduated from Yale University, 1898, with degree of B.A.; statistician for Brown Brothers & Co., bankers, New York.

LEWIS R. FREEMAN (*American Trade Opportunities and Handicaps in South America*)—Born 1878, in California; educated at Leland Stanford Jr. University; has just completed a three and one-half years' tour of the world, including six months in the South Seas, fourteen months between Australia, South Africa, and Europe, and eighteen months in the countries of South America, six months of this being in Argentina.

P. H. ASHMEAD (*The Railway Development of the Philippines*)—Graduated from Lehigh University, 1888, and was engaged in survey and construction work, chiefly railroad, until 1893; then connected with the Sanitary District of Chicago as sub-engineer of construction on the drainage canal until 1897, when he became chief of party under the United States Deep Waterways Commission, engaged in reconnoissance and stream measurement on the Hudson and Niagara rivers and in the Province of Quebec; 1898-1901, locating and division engineer on the Guayaquil & Quito Railway, Ecuador; 1901-1902, similarly employed on the central division of the Cuba Company's railway lines; in 1902 was associated with the Canton-Hankow Railway as principal assistant engineer; in 1903 became chief engineer of some 300 miles of railway reconnoissance across the Panhandle of Texas, and later consulting engineer on the Seaboard Air Line; re-entered the service of the American-China Development Co. in 1904 as chief of the technical department, with headquarters in New York, and was appointed engineer-in-chief of the Canton-Hankow line in 1905. Early in 1906 Mr. Ashmead was appointed secretary of the Philippine Railway Co.

WILLIAM O. WEBBER (*The Comparative Cost of Steam and Hydro-Electric Power*)—Born Springfield, Mass., 1856; educated in public schools of Manchester and Portsmouth, N. H., and in New York City. Mechanical Engineer, 1875, Toledo, Peoria & Warsaw Railway, Peoria, Ill.; engineering representative, 1876, Centennial Exhibition, Chapman Valve Co., and assistant in turbine tests; engineer of tests, 1876-81, Chicago, Burlington & Quincy R. R., Aurora, Ill.; superintendent, 1881-82, Allen Paper Car Wheel Works, Pullman, Ill.; superintendent and partner, 1882-87, Lawrence Machine Co., Lawrence, Mass.; general superintendent, 1889-94, Erie City Iron Works, Erie, Pa.; at present consulting engineer in Boston, Mass.; is a member of the American Society of Mechanical Engineers, and Boston Society of Civil Engineers, and an associate member of the United States Naval Institute.

H. L. WHITTEMORE (*Graphical Wall Records for the Production Department*)—Born in Milwaukee, Wis., in 1875 and was educated in the schools of that place; spent several years as apprentice and machinist in shops in his home city and in Hartford, Conn.; in 1900, entered the University of Wisconsin and completed the course in mechan-

ical engineering in 1902; became assistant superintendent of the Sullivan Machinery Company of Claremont, N. H., which position he resigned in 1905 to act as assistant to A. P. Hanson of Berlin, Germany, on experimental laboratory work; in 1906 was employed in systematizing in the Control Division of the British Westinghouse Electric and Manufacturing Company, Manchester, England. Is at present instructor in the laboratory of applied mechanics of the University of Illinois.

D. C. NEWMAN COLLINS (*The Design and Construction of Industrial Buildings*)—A consulting engineer and architect, with wide experience in the design and superintendence of the structural part of many important buildings, including the Mather building, Cleveland, Betz building, Phila., Amphitheatre roof, Madison Square Garden, N. Y. World building, Lawyers' Title building, Dun building, Siegel-Cooper building, and Clearing House, N. Y., Charleston post office, S. C., and many bridges, piers and smaller structures. In industrial plants he has designed and managed the construction of Milliken Bros.' Brooklyn plant; the Atlas Cement plant at Northampton, Pa.; the mill building of the Union Iron Works and the Ewa sugar mill, Honolulu; extensive additions to the plant of the Warren Foundry & Machine Co., Phillipsburg, N. J.; structural parts of the Lehigh Valley repair shops, Sayre, Pa.; the new plant of the Pneumatic Signal Co., Rochester, N. Y.; the erecting shop of the De La Vergne Machine Co., N. Y.; and the ten-acre plant of the Lidgerwood Mfg. Co., Waverly. Some of these are reinforced concrete, some brick and steel, and a few of timber. He is a member of the A. S. C. E. and is registered as an architect.

CHARLES U. CARPENTER (*Profit Making in Shop and Factory Management*)—A graduate of Princeton University with the degrees of mechanical and electrical engineer, has had a large experience in mining engineering and electrical manufacturing and in the supervision of large manufacturing plants; for some years he was factory supervisor and afterwards head of the labor department of the National Cash Register Company, Dayton, Ohio, U. S. A. Later took a similar position with the Herring-Hall-Marvin Safe Company, rising rapidly to the presidency of the concern.


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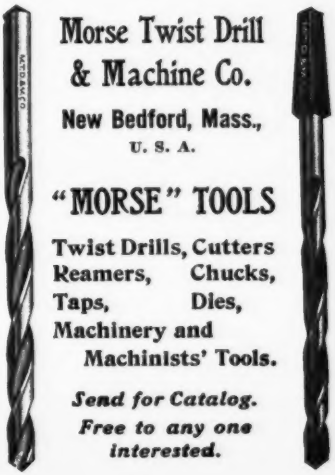

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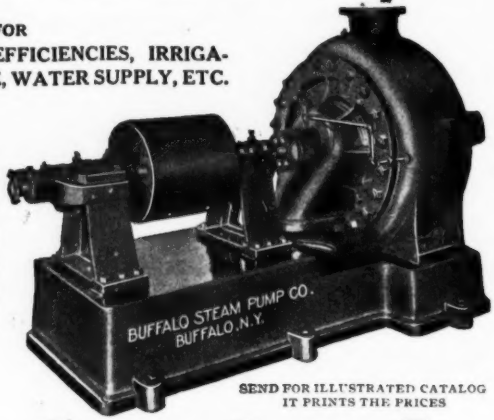


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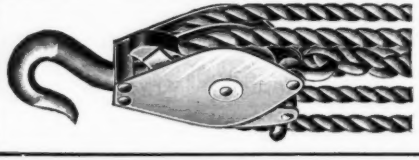

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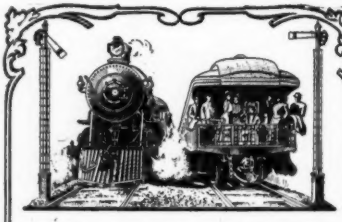

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Viennot Advertising Agency, Phila.

### Abrasive Material (Alundum).
Norton Co., Worcester, Mass.

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Baker-Vawter Co., Chicago.
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Gunn, Richards & Co., New York.
Pentlarge, Th., New York.

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Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.
Worthington, Henry R., New York.

### Adding Machines.
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Kolesch & Co., New York.
Keuffel & Esser Co., New York.

### Aerial Tramways.
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Lambert Hoist Engine Co., Newark.
Lidgerwood Mfg. Co., New York.
Trenton Iron Co., Trenton, N. J.

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Blake Mfg. Co., Geo. F., New York.
Chicago Pneu. Tool Co., Chicago.
Clayton Air Compress. Wks., N. Y.
Curtis & Co., Mfg. Co., St. Louis.
Deane Steam Pump Co., New York.
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Westinghouse Air Brake Co., Pittsburg.

### Air Drills.
Amer. Air Compressor Wks., N. Y.
Chicago Pneu. Tool Co., Chicago.
Clayton Air Compressor Works, N. Y.
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Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago.

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Amer. Air Compressor Works, N. Y.
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### Air Washers & Humidifiers.
Buffalo Forge Co., Buffalo.

### Ammeters.
Western Electric Co., Chicago.
Weston Elec. Inst. Co., Waverly Pk., Newark, N. J.

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Ostrander & Co., W. R., New York.
Western Electric Co., Chicago.

### Anti-Friction Metals.
Phosphor Bronze Smelting Co., Phila.
Poole Eng. & Mch. Co., Baltimore.

### Architects.
Collins, D. C. Newman, New York.
Dodge & Day, Philadelphia.

### Asphalt Paving Plant.
Warren Bros. Co., Boston.

### Automatic Grab Buckets.
Hayward Co., New York.
National Equipment Co., Chicago.

### Automatic Weighing Machines.
Automatic Weighing Machine Co., Newark.
Richardson Scale Co., New York.

### Automobile Drop Forgings.
Chicago Drop Forge & Foundry Co., Kensington, Ill.

### Automobile Parts.
Locke Regulator Co., Salem, Mass.

### Ballast Unloaders.
Marion Steam Shovel Co., Marion, O.

### Ball Bearings.
American Ball Co., Providence.
Pressed Steel Mfg. Co., Phila., Pa.

### Band Saws.
Fay & Egan Co., Cincinnati.

### Bascule Bridges.
Fawcus Machine Co., Pittsburg.
Wallace-Coates Eng'g Co., Chicago.

### Balanced Valve.
Locke Regulator Co., Salem, Mass.
Mason Regulator Co., Boston.

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Jeffrey Mfg. Co., Columbus.
Caldwell & Son Co., H. W., Chicago.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Webster Mfg. Co., Chicago.

### Belt Dressing (Waterproof).
Dixon Crucible Co., Jos., Jersey City.

### Belting.
Boston Belting Co., Boston.
Eureka Fire Hose Co., New York.
Jeffrey Mfg. Co., Columbus.
Link-Belt Co., Chicago.
Main Belting Co., Philadelphia.

### Belt Lacing.
Bristol Co., Waterbury, Conn.
Robins Conveying Belt Co., N. Y.

### Belt Shifters.
Mason Regulator Co., Boston.

### Bending Rolls.
Niagara Mch. & Tool Wks., Buffalo.
Niles-Bement-Pond Co., New York.
Sellers Co., Inc., William, Phila.
Williams, White & Co., Moline.

### Binding Devices.
Baker-Vawter Co., Chicago.

### Bitulithic Pavement.
Warren Bros. Co., Boston.

### Blast Furnaces.
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McClure, Son & Co., G. W., Pittsburg.
Riter-Conley Mfg. Co., Pittsburg.

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American Blower Co., Detroit.
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Massachusetts Fan Co., Watertown, Mass.
Ohio Blower Co., Cleveland.
Platt Iron Works, Dayton, Ohio.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.
Wing Mfg. Co., L. J., New York.

### Blowers, Turbine.
De Laval Stm. Turbine Co., Trenton.
Wing Mfg. Co., L. J., New York.

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Keuffel & Esser Co., New York.
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American Drafting Furniture Co., Rochester.
Kolesch & Co., New York.

### Blue Print Frames.
American Drafting Furniture Co., Rochester.
Kolesch & Co., New York.

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Keuffel & Esser Co., New York.
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### Boiler Door Arches.
McLeod & Henry Co., Troy, N. Y.

### Boiler Feeds.
Keyes & Son, F. E., New York.

### Boiler Feeders.
Lunkenheimer Co., Cincinnati.
Hancock Inspirator Co., N. Y.
Hayden & Derby Mfg. Co., N. Y.

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Amer. Steam Gauge & Valve Mfg. Co., Boston.
Ashcroft Mfg. Co., N. Y.
Consolidated Safety Valve Co., N. Y.
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Lunkenheimer Co., Cincinnati.

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McLeod & Henry Co., Troy, N. Y.
Mecklenburg Iron Works, Charlotte, N. C.
Walworth Mfg. Co., Boston.

### Boiler Inspection and Insurance.

Fidelity & Casualty Co., New York.
Maryland Casualty Co., Baltimore.

### Boilers.

Atlantic Works, East Boston, Mass.
Atlas Engine Works, Indianapolis.
Babcock & Wilcox Co., New York.
Beggs & Co., James, New York.
Harrison Safety Boiler Wks., Phila.
Heine Safety Boiler Co., St. Louis.
Kingsford Foundry & Machine Wks., Oswego, N. Y.
Oil Well Supply Co., Oswego, N. Y.
Parker Boiler Co., Philadelphia.
Platt Iron Works, Dayton, Ohio.
Platt & Co., John, New York.
Riter-Conley Mfg. Co., Pittsburg.
Robb-Mumford Boiler Co., So. Framingham, Mass.
Smith & Son Co., Sam'l, Paterson,
Tippett & Wood, Phillipsburg, N. J.
Walsh's Boiler Wks., Holyoke, Mass.
Wetherill & Co., Robt., Chester, Pa.

### Bolt and Nut Machinery.

Niles-Bement-Pond Co., New York.

### Boosters.

C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Western Electric Co., Chicago.

### Boring Mills.

Niles-Bement-Pond Co., New York.
Sellers Co., William, Inc., Phila.
Williams, White & Co., Moline, Ill.

### Brakes—Friction.

Elec. Controller & Supply Co., Cleveland.

### Brass Founders' Supplies.

Blake Mfg. Co., Geo. F., New York.
Obermayer Co., S., Cincinnati.

### Brass Makers' Lathes.

Am. Tool & Machine Co., Boston.
Niles-Bement-Pond Co., New York.

### Breast Drill, Electric.

Clark, Jas., Jr., Elec. Co., Inc., Louisville.

### Brick.

Maurer & Son, Henry, New York.

### Brick and Tile Machinery.

American Blower Co., Detroit.
Jeffrey Mfg. Co., Columbus.

### Bridges, Roofs, Etc.

Aberthaw Construction Co., Boston.
Berlin Const'n Co., Berlin, Conn.
Brown Hoisting Mchy. Co., Cleveland.
Cowing Engineering Co., Cleveland.
Curtis-Ruggles Co., New York.
Fawcus Machine Co., Pittsburg.
Interstate Eng'ng Co., Cleveland.
Riter-Conley Mfg. Co., Pittsburg.
Scherzer Rolling Lift Bridge Co., Chicago.
Tippett & Wood, Phillipsburg, N. J.
Trussed Concrete Steel Co., Detroit.
Tucker & Vinton, New York.
Wallace-Coates Eng'g Co., Chicago.
Walsh's Boiler Wks., Holyoke, Mass.

### Bronze Castings.

D'Este Co., Julian, Boston.

### Bucket Elevators.

Hayward Co., The, New York.
Jeffrey Mfg. Co., Columbus.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Webster Mfg. Co., Chicago.

### Buildings, Iron, Steel and Steel Concrete.

Aberthaw Construction Co., Boston.
Berlin Constr'n Co., Berlin, Conn.
Brown Hoisting Mchy. Co., Cleveland.
Curtin-Ruggles Co., New York.
Interstate Eng'g Co., Cleveland.
Trussed Concrete Steel Co., Detroit.
Tucker & Vinton, New York.
Turner Construction Co., New York.

### Bulldozers.

Niles-Bement-Pond Co., New York.
Williams, White & Co., Moline, Ill.

### Bunkers, Coal, Ore, Etc.

Berquist, A. Samuel, Brooklyn.

### Business Systems.

Baker-Vawter Co., Chicago.
Cooper & Co., John A., Chicago.
Gunn, Richards & Co., New York.
Pentlarge, Th., New York.
Williams & Staff, Stephen T., N. Y.

### Cable-Railway Machinery.

Mead-Morrison Mfg. Co., Boston.
Poole Eng'g & Mch. Co., Baltimore.
Robins Conveying Belt Co., N. Y.

### Cables, Elec. & Submarine.

General Electric Co., New York.
Western Electric Co., Chicago.

### Cableways—

(See Aerial Tramways.)

### Cables, Wire.

Lidgerwood Mfg. Co., New York.
Trenton Iron Co., Trenton, N. J.

### Calculating Machines.

Felt & Tarrant Mfg. Co., Chicago.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.

### Calorimeters.

Amer. Steam Gauge & Valve Mfg. Co., Boston.

### Carborundum.

Carborundum Co., Niagara Falls, N. Y.

### Cars.

Browning Eng'g Co., Cleveland.
Industrial Eng'g Co., Cleveland.
Mead-Morrison Mfg. Co., Boston.
Mecklenburg Iron Works, Charlotte, N. C.

### Car Shop Machinery.

Fay & Egan Co., Cincinnati.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

### Castings, Iron, Steel & Brass.

Buffalo Foundry Co., Buffalo.
Caldwell & Son Co., H. W., Chicago.
Curtis & Co. Mfg. Co., St. Louis.
Fawcus Machine Co., Pittsburg.
Flagg & Co., Stanley G., Phila.
Jeffrey Mfg. Co., Columbus.
Lunkenheimer Co., Cincinnati.
Lynchburg Foundry Co., Lynchburg, Va.
Mecklenburg Iron Works, Charlotte, N. C.
Poole Eng'g & Mch. Co., Baltimore.
Southwalk Fdy. & Mch. Co., Phila.
Walworth Mfg. Co., Boston.
Wetherill & Co., Robt., Chester, Pa.

### Cast-Iron Pipe.

Lynchburg Foundry Co., Lynchburg, Va.
U. S. Cast Iron Pipe & Fdy. Co., Phila.
Walworth Mfg. Co., Boston.
Wood & Co., R. D., Phila.

### Cement Machinery.

Automatic Weighing Machine Co., Newark.
Bradley Pulverizer Co., Boston.
Caldwell & Sons Co., H. W., Chicago.
Dunning, W. D., Syracuse, N. Y.
Jeffrey Mfg. Co., Columbus.
Lehigh Car Wheel & Axle Works, Catasauqua, Pa.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Ruggles-Coles Eng'g Co., New York.
Smidth & Co., F. L., New York.
Vulcan Iron Wks., Wilkes-Barre, Pa.
Webster Mfg. Co., Chicago.

### Cement, Portland.

Alsen's Am. Portland Cement Co., New York.
American Cement Co., Phila.
Atlas Portland Cement Co., N. Y.
Glens Falls Portland Cement Co., Glens Falls, N. Y.
Lehigh Portland Cement Co., Allentown, Pa.

### Chains.

Diamond Chain & Mfg. Co., Indianapolis.
Morse Chain Co., Ithaca, N. Y.

### Chain Belting.

Caldwell & Sons Co., H. W., Chicago.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Morse Chain Co., Ithaca, N. Y.
Webster Mfg. Co., Chicago.

### Chain Joint.

Morse Chain Co., Trumansburg, N.Y.

### Channeling Machines.

Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago.

### Checks, Time, Pay & Trade.

Amer. Ry. Supply Co., New York.
Schwerdtle Stamp Co., Bridgeport.

### Chemicals.

Roessler & Hasslacher Chem. Co.,

### Chemists.

Hunt & Co., Robt. W., Chicago.
Lunkenheimer Co., Cincinnati.

### Chucks.

Almond Mfg. Co., Brooklyn.
American Tool & Mch. Co., Boston.
Niles-Bement-Pond Co., New York.

### Clutches, Magnetic.

Elec. Controller & Supply Co., Cleveland.

### Clutch Pulleys.

Akron Clutch Co., Akron, Ohio.
Caldwell & Sons Co., H. W., Chicago.

### Coal and Ashes-Handling Machinery.

Browning Eng'g Co., Cleveland.
Brown Hoisting Mchy. Co., Cleveland.
Caldwell & Sons Co., H. W., Chicago.
Hayward Co., New York.
Hunt Co., C. W., New York.
Interstate Eng'g Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Link-Belt Eng'g Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Webster Mfg. Co., Chicago.

### Coal Cutters (Air and Electric).

Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.
Sullivan Machinery Co., Chicago.

### Coal and Ore Bunkers.

Berquist, A. Samuel, Brooklyn.

### Coal Weighing Machine, Automatic.

Automatic Weighing Machine Co., Newark.
Buffalo Scale Co., Buffalo.
Richardson Scale Co., New York.

### Coal-Mining Machinery.

Blake Mfg. Co., Geo. F., New York.
General Electric Co., New York.
Hunt Co., C. W., New York.
Ingersoll-Rand Co., New York.
Interstate Eng'g Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.

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Laidlaw-Dunn-Gordon Co., New York.
Lambert Hoist, Engine Co., Newark.
Link-Belt Eng'g Co., Phila.
McGowan Co., John H., Cincinnati.
Norwalk Iron Wks., So. Norwalk, Ct.
Robins Conveying Belt Co., N. Y.
Sullivan Machinery Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Worthington, Henry R., New York.

### Coal Screens.

Hendrick Mfg. Co., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Tyler Co., W. S., Cleveland.

### Coatings, Waterproof.

Winslow Co., E. J., Chicago.

### Cocks.

Lunkenheimer Co., Cincinnati.

### Coil Pipe.

Whitlock Coil Pipe Co., Hartford.

### Commercial Trucks, Gasoline.

Industrial Eng'g Co., Cleveland.

### Comptometers.

Felt & Tarrant Mfg. Co., Chicago.

### Concrete Mixers.

Contractors' Supply & Equip. Co., Chicago.
Dobbie Foundry & Machine Co., Niagara Falls.
Dunning, W. D., Syracuse, N. Y.
Jeffrey Mfg. Co., Columbus.
Municipal Eng. & Contracting Co., Chicago.

### Concrete Piles.

Raymond Concrete Pile Co., Chicago.

### Concrete Reinforcing.

American System of Reinforcing, Chicago.

### Condensers.

Alberger Condenser Co., New York.
Blake Mfg. Co., Geo. F., New York.
Deane Steam Pump Co., New York.
Epping-Carpenter Co., Pittsburg.
Guild & Garrison, Brooklyn.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., N. Y.
McGowan Co., John H., Cincinnati.
Platt Iron Works, Dayton, O.
Snow Steam Pump Wks., New York.
Southwark Fdy. & Mch. Co., Phila.
Wheeler Condenser & Eng'g Co.,N.Y.
Worthington, Henry R., New York.

### Continuous Elevators.

Caldwell & Son Co., H. W., Chicago.

### Contractors, General.

Curtin-Ruggles Co., New York.
Fawcus Machine Co., Pittsburg.
Trussed Concrete Steel Co., Detroit.
Tucker & Vinton, New York.
Turner Construction Co., New York.
White & Co., J. G., New York.

### Conduit Systems.

Gest, G. M., New York.

### Controllers.

Cutler-Hammer Mfg. Co., Milwaukee.
Elec. Controller & Supply Co., Cleveland.

### Conveying Machinery.

Brown Hoisting Mchy. Co., Cleveland.
Browning Eng'g Co., Cleveland.
Caldwell & Sons Co., H. W., Chicago.
Dobbie Foundry & Machine Co., Niagara Falls.
Hayward Co., The, New York.
Hunt Co., C. W., New York.
Interstate Eng'g Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Link-Belt Co., Phila.
Maris Bros., Philadelphia.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Trenton Iron Co., Trenton, N. J.
Webster Mfg. Co., Chicago.

### Conveying Systems.

Sturtevant Co., B. F., Hyde Park, Mass.

### Cooling Towers.

Alberger Condenser Co., New York.
Stocker, George, St. Louis.
Wheeler Condenser & Eng'g Co.,N.Y.
Worthington, Henry R., New York.

### Copper Window Frames and Sashes.

Voigtmann & Co., Chicago.

### Cordage.

American Mfg. Co., New York.

### Core Ovens.

Millett Core Oven Co., Brightwood, Mass.

### Cost Systems.

Baker-Vawter Co., Chicago.
Cooper & Co., John A., Chicago.
Gunn, Richards & Co., New York.
Pentlarge, Th., New York.
Williams & Staff, Stephen T., N. Y.

### Cotton Oil Machinery.

Laidlaw-Dunn-Gordon Co., New York.
Platt Iron Works, Dayton, Ohio.

### Couplings.

Almond Mfg. Co., Brooklyn.

### Cranes.

Brown Hoisting Mchy. Co., Cleveland.
Browning Eng'g Co., Cleveland.
Bucyrus Co., So. Milwaukee.
Dobbie Foundry & Machine Co., Niagara Falls.
Hayward Co., The, New York.
Interstate Eng'g Co., Cleveland.
Maris Bros., Philadelphia.
Niles-Bement-Pond Co., New York.
Riter-Conley Mfg. Co., Pittsburg.
Wood & Co., R. D., Phila.

### Crane Motors.

Browning Eng'g Co., Cleveland.
Western Electric Co., Chicago.

### Crane Scales.

Buffalo Scale Co., Buffalo.

### Crucibles.

Dixon Crucible Co., Jos., Jersey City.
Obermayer Co., S., Cincinnati.

### Crusher, Ore, Phosphate, Rock.

Jeffrey Mfg. Co., Columbus.
Lehigh Car, Wheel & Axle Works, Catasauqua, Pa.
Smidth & Co., F. L., New York.

### Cupolas.

Obermayer Co., S., Cincinnati.
Riter-Conley Mfg. Co., Pittsburg.

### Cutters, Milling.

Becker-Brainard Mill. Mch. Co., Hyde Park, Mass.
Pratt & Whitney Co., Hartford.

### Damper Regulator.

D'Este Co., Julian, Boston.
Locke Regulator Co., Salem, Mass.
Mason Regulator Co., Boston.

### Derricks and Fittings.

Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
Contractors' Plant Mfg. Co., Buffalo.
Dobbie Foundry & Machine Co., Niagara Falls.
National Equipment Co., Chicago.

### Digesters.

Atlantic Works, East Boston, Mass.
Riter-Conley Mfg. Co., Pittsburg.
Tippett & Wood, Phillipsburg, N. J.
Wetherill & Co., Robt., Chester, Pa.

### Ditching Machines.

Austin Drainage Excavator Co., F. C., Chicago.
Municipal Eng. & Contracting Co., Chicago.

### Draft, Mechanical.

Buffalo Forge Co., Buffalo.
Exeter Machine Wks., Exeter, N. H.
Massachusetts Fan Co., Watertown, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Wing Mfg. Co., L. J., New York.

### Drafting Machine.

Universal Drafting Machine Co., Cleveland.

### Drafting Room Equipment.

American Drafting Furniture Co., Rochester.
Kolesch & Co., New York.
Universal Drafting Machine Co., Cleveland.

### Drawing Paper.

Kolesch & Co., New York.
Mittineague Paper Co., Mittineague, Mass.

### Drawing Tables and Boards.

American Drafting Furniture Co., Rochester.

### Drilling Machines.

American Tool Wks. Co., Cincinnati.
Barnes Co., W. F. & J., Rockford, Ill.
Chicago Pneu. Tool Co., Chicago.
Clark, Jr., & Co., Jas., Louisville.
Ingersoll-Rand Co., New York.
Keystone Traction Drill Co., Beaver Falls, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Sellers Co., Inc., William, Phila.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

### Drills, Diamond Core.

Ingersoll-Rand Co., New York.
Standard Diamond Drill Co., Chicago.
Sullivan Machinery Co., Chicago.

### Drills—Rock and Coal.

Chicago Pneu. Tool Co., Chicago.
Clayton Air Compress Wks., N. Y.
Hall Steam Pump Co., Pittsburg.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.
Keystone Traction Drill Co., Beaver Falls, Pa.
Smidth & Co., F. L., New York.
Standard Diamond Drill Co., Chicago.
Sullivan Machinery Co., Chicago.

### Drop Forgings.

Anderson Forge & Machine Co., Detroit, Mich.
Chicago Drop Forge & Fdy. Co., Kensington, Ill.
Wyman & Gordon, Worcester, Mass.

### Drop Hammers.

Williams, White & Co., Moline.

### Drying Apparatus.

Buffalo Forge Co., Buffalo.
Sturtevant Co., B. F., Hyde Park, Mass.

### Dumps, Automatic.

Jeffrey Mfg. Co., Columbus.
Sullivan Machinery Co., Chicago.

### Dump Wagons.

Contractors' Supply & Equipment Co., Chicago.

### Dust Collecting Systems.

Ohio Blower Co., Cleveland.

### Dynamos.

C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Lincoln Motor Works Co., Cleveland.
Northern Elec. Mfg. Co., Madison.

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Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.

### Dynamos, Steam Turbine.

De Laval Steam Turbine Co., Trenton.

### Elbows, Pipe.

Lunkenheimer Co., Cincinnati.
Whitlock Coil Pipe Co., Hartford.

### Electric Bells.

Ostrander & Co., W. R., New York.
Western Electric Co., Chicago.

### Electric Grinder.

Hisey-Wolf Machine Co., Cincinnati.

### Electric Heating Apparatus.

Simplex Elec. Heating Co., Cambridgeport, Mass.
Western Electric Co., Chicago.

### Electric Hoists.

Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
C & C Electric Co., New York.
Hunt Co., C. W., New York.
Dobbie Foundry & Machine Co., Niagara Falls.
Lambert Hoist Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., Boston.
National Equipment Co., Chicago.
Niles-Bement-Pond Co., New York.
Western Electric Co., Chicago.

### Electrical Furnaces.

Engelhard, Charles, New York.

### Elec. Measuring Instruments.

Weston Elec. Instrument Co., Waverly Park, Newark, N. J.

### Elec. Welding Outfits.

C & C Electric Co., New York.

### Elevating and Conveying Machinery.

Dobbie Foundry & Machine Co., Niagara Falls.
Jeffrey Mfg. Co., Columbus.
National Equipment Co., Chicago.
Webster Mfg. Co., Chicago.

### Elevator Insurance.

Fidelity & Casualty Co., New York.
Maryland Casualty Co., Baltimore.

### Elevators.

Caldwell & Son Co., H. W., Chicago.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Obermayer Co., S., Cincinnati.
Poole Eng'g Mch. Co., Baltimore.

### Elevator Pressure Regulator.

Mason Regulator Co., Boston.

### Employers' Liability Insurance.

Fidelity & Casualty Co., New York.
Maryland Casualty Co., Baltimore.

### Engineering Instruments.

Altenedер & Sons, Theo., Phila.
Brandis Sons Co., Brooklyn.
Buff & Buff Mfg. Co., Boston.
Dietzgen Co., Eugene, Chicago.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.
Queen & Co., Philadelphia.
Young & Sons, Philadelphia.

### Engineers.

Arnold Co., Chicago.
Baum, Frank G., San Francisco.
Brill, Geo. M., Chicago.
Collins, D. C. Newman, New York.
Cooper & Co., John A., Chicago.
Currey, Harold Y., Chicago.
Demming, Henry C., Harrisburg, Pa.
Doble Co., Abner, San Francisco.
Doble, Robt. McF., Colorado Springs, Colo.
Dodge & Day, Philadelphia.
Fawcus Machine Co., Pittsburg.
Green, Carl R., Dayton, O.
Gunn, Richards & Co., New York.
Hunt & Co., Robt. W., Chicago.
Ilmer & Co., Cincinnati.
Industrial Eng'g Co., Cleveland.
Keyes & Son, F. E., New York.
Kennedy, Julian, Pittsburg.
Kennedy, Walter, Pittsburg.
McClure, Son & Co., G. W., Pittsburg.
Merk & Krutmeyer, Johnstown, Pa.
Palmer, W. K., Kansas City.
Pentlarge, Th., New York.
Porter, H. F. J., New York.
Robinson, A. W., Montreal, Canada.
Roelker, H. B., New York.
Von Schon, H., Detroit.
Wallace-Contes Eng'g Co., Chicago.
White & Co., J. G., New York.
Williams & Staff, Stephen T., N. Y.
Wood, George R., Pittsburg.

### Engines, Blowing.

American Blower Co., Detroit.
Platt Iron Works, Dayton, Ohio.
Southwark Fdy. & Mch. Co., Phila.

### Engines, Marine.

Atlantic Works, East Boston, Mass.

### Engines—Gas and Gasoline.

Beggs & Co., James, New York.
De La Vergne Machine Co., N. Y.
Snow Steam Pump Wks., New York.
Westinghouse Mch. Co., Pittsburg.
Westinghouse, Church, Kerr & Co., New York.

### Engines, Steam.

American Blower Co., Detroit.
Atlas Engine Works, Indianapolis.
Ball Engine Co., Erie, Pa.
Beggs & Co., James, New York.
Brown Hoisting Mchy. Co., Cleveland.
Buffalo Forge Co., Buffalo.
Harrisburg Fdy. & Mch. Wks., Harrisburg, Pa.
Hooven, Owens, Rentschler Co., Hamilton.
Mecklenburg Iron Works, Charlotte, N. C.
Ohio Blower Co., Cleveland.
Providence Eng'g Wks., Providence.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Southwark Fdy. & Mch. Co., Phila.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse, Church, Kerr & Co., New York.
Westinghouse Mch. Co., Pittsburg.
Wetherill & Co., Robt., Chester, Pa.

### Engineering Specialties.

D'Este Co., Julian, Boston.
Lunkenheimer Co., Cincinnati.

### Engine Stops.

Locke Regulator Co., Salem, Mass.

### Engravers.

Gatchel & Manning, Phila.

### Evaporators.

Blake Mfg. Co., Geo. F., New York.
Knowles Steam Pump Wks., N. Y.

### Excavators.

Austin Drainage Excavator Co., F. C., Chicago.
Browning Engineering Co., Cleveland.
Bucyrus Co., So. Milwaukee, Wis.
Hayward Co., The, New York.
Jeffrey Mfg. Co., Columbus.
Marion Steam Shovel Co., Marion, O.
Municipal Eng. & Contracting Co., Chicago.
Robins Conveying Belt Co., N. Y.

### Exhaust Heads.

Am. Spiral Pipe Wks., Chicago.
Direct Separator Co., Syracuse.
Hoppes Mfg. Co., Springfield, O.
Sturtevant Co., B. F., Hyde Park, Mass.
Watson & McDaniel Co., Phila.
Wright Mfg. Co., Detroit.

### Exhaust Heads, (Cast Iron).

Ohio Blower Co., Cleveland.

### Expanded Metal.

Associated Expanded Metal Cos., New York.
Roebling Construction Co., N. Y.

### Fans, Electric.

Western Electric Co., Chicago.
Wing Mfg. Co., L. J., New York.

### Fans, Ventilating.

American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Green Fuel Economizer Co., Matteawan, N. Y.
Massachusetts Fan Co., Watertown, Mass.
Power Specialty Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Sullivan Machinery Co., Chicago.
Western Electric Co., Chicago.
Wing Mfg. Co., L. J., New York.

### Feed Water Heaters and Purifiers.

Beggs & Co., James, New York.
Blake Mfg. Co., Geo. F., New York.
Goubert Mfg. Co., New York.
Green Fuel Economizer Co., Matteawan, N. Y.
Harrison Safety Boiler Wks., Phila.
Hoppes Mfg. Co., Springfield, O.
Keyes & Son, F. E., New York.
Knowles Steam Pump Wks., N. Y.
McGowan Co., John H., Cincinnati.
Petroleum Iron Wks. Co., Washington, Pa.
Platt Iron Works, Co., Dayton.
Providence Eng'g Wks., Providence.
Ross Valve Mfg. Co., Troy.
Scaife & Sons Co., Wm. B., Pittsburg.
Stewart Heater Co., Buffalo.
Webster & Co., Warren, Camden, N. J.
Whitlock Coil Pipe Co., Hartford.
Wetherill & Co., Robt., Chester, Pa.
Wheeler Condenser & Eng'g Co., New York.
Worthington, Henry R., New York.

### Feed Water Regulators.

Chaplin-Fulton Mfg. Co., Pittsburg.
Locke Regulator Co., Salem, Mass.

### Felt, Waterproof.

Hydex Felt & Eng'g Co., New York.

### Ferro-Vanadium.

American Vanadium Co., Pittsburg.

### Files and Rasps.

Barnett Co., G. & H., Phila.
Nicholson File Co., Providence.

### Filing Cabinets.

Globe-Wernicke Co., Cincinnati.

### Filter Presses.

Am. Tool & Machine Co., Boston.
Niles-Bement-Pond Co., New York.

### Filters.

Beggs & Co., James, New York.
Keyes & Son, F. E., New York.
Koven & Bro., L. O., New York.
Ross Valve Mfg. Co., Troy.
Scaife & Sons Co., Wm. B., Pittsburg.
Wetherill & Co., Robt., Chester, Pa.

### Fire Box Blocks.

McLeod & Henry Co., Troy, N. Y.

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### Fire Brick.

Maurer & Son, Henry, New York.
Obermayer Co., S., Cincinnati.

### Fireproof Building Materials.

Maurer & Son, Henry, New York.
National Fire Proofing Co., Chicago.
Roebling Construction Co., New York.

### Fireproof Doors.

Rapp, John W., New York.

### Fittings.

Pittsburg Valve & Fittings Co., Pittsburg.

### Flanges.

Dart Mfg. Co., E. M., Providence.
Lunkenheimer Co., Cincinnati.

### Flanges—Forged Steel.

Am. Spiral Pipe Wks., Chicago.

### Flexible Shafts.

Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

### Flexible Steel Tubing.

Almond Mfg. Co., Brooklyn.

### Float Valves.

Foster Eng'g Co., Newark.
Locke Regulator Co., Salem, Mass.

### Floor and Sidewalk Lights.

Brooks & Co., T. H., Cleveland.

### Fly Wheel Insurance.

Maryland Casualty Co., Baltimore.

### Fly Wheels.

Poole Eng'g & Mch. Co., Baltimore.
Wetherill & Co., Robt., Chester, Pa.

### Forges.

Buffalo Forge Co., Buffalo.
Ingersoll-Rand Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

### Forgings, Iron and Steel.

Anderson Forge & Machine Co., Detroit, Mich.
Chicago Drop Forge & Fdy. Co., Kensington, Ill.
Fawcus Machine Co., Pittsburg.
Wyman & Gordon, Worcester.

### Foundry Equipment.

Blake Mfg. Co., Geo. F., New York.
Buffalo Foundry Co., Buffalo.
Hunt Co., C. W., New York.
Ingersoll-Rand Co., New York.
Millett Core Oven Co., Brightwood, Mass.
Obermayer Co., S., Cincinnati.
Smith Fdy. Supply Co., J. D., Cleveland.

### Foundry Supplies.

Ingersoll-Rand Co., New York.
Obermayer & Co., S., Cincinnati.
Smith Fdy. Supply Co., J. D., Cleveland.
U. S. Graphite Co., Saginaw, Mich.

### Friction Clutches.

Akron Clutch Co., Akron, Ohio.
Am. Tool & Mch. Co., Boston.
Caldwell & Son Co., H. W., Chicago.
Cutler-Hammer Mfg. Co., Milwaukee.
Elec. Controller & Supply Co., Cleveland.
Link-Belt Co., Phila.
Poole Eng'g & Mch. Co., Baltimore.

### Fuel Economizers.

Green Fuel Economizer Co., Matteawan, N. Y.
Providence Eng'g Wks., Providence.
Sturtevant Co., B. F., Hyde Park, Mass.

### Furnace Builders.

Am. Gas Furnace Co., New York.
Continental Iron Wks., Brooklyn.
Hawley Down Draft Furnace Co., Chicago.
Kennedy, Julian, Pittsburg.
McClure, Son & Co., G. W., Pittsburg.
Morgan Const. Co., Worcester.
Riter-Conley Mfg. Co., Pittsburg.

### Fused Silica Ware.

Engelhard, Charles, New York.

### Gages—Pressure, Steam, Water.

American Steam Gauge & Valve Mfg. Co., Boston.
Ashcroft Mfg. Co., New York.
Ashton Valve Co., Boston.
Bristol Co., Waterbury, Conn.
Hohmann & Maurer Mfg. Co., Rochester.
Lunkenheimer Co., Cincinnati.
Manning, Maxwell & Moore, N. Y.
Star Brass Mfg. Co., Boston.
Schaeffer & Budenberg Mfg. Co., Foxboro, Mass.
Standard Gauge Mfg. Co., Syracuse.
Walworth Mfg. Co., Boston.

### Galvanizing.

Koven & Bro., L. O., New York.

### Gas Blowers and Exhausters.

Buffalo Forge Co., Buffalo.
Sturtevant Co., B. F., Hyde Park, Mass.

### Gas-Composimeters.

Uehling Instrument Co., Passaic, N. J.

### Gas Engines.

Wile Power Gas Co., Rochester.

### Gas Engine Experts.

Illmer & Co., Cincinnati.

### Gas Engine Indicators.

Amer. Steam Gauge & Valve Mfg. Co., Boston.
Schaeffer & Budenberg Mfg. Co., Foxboro, Mass.

### Gas Machines & Generators.

Am. Gas Furnace Co., New York.
Morgan Const. Co., Worcester.
Walworth Mfg. Co., Boston.
Wile Power Gas Co., Rochester.
Wood & Co., R. D., Phila.

### Gas Producers.

Morgan Construction Co., Worcester.
Wile Power Gas Co., Rochester.

### Gaskets.

Am. Spiral Pipe Wks., Chicago.
Boston Belting Co., Boston.

### Gear Cutting Machines.

Becker-Brainard Mill. Mch. Co., Hyde Park, Mass.
Pratt & Whitney Co., Hartford.

### Gearing.

Bilgram, Hugo, Phila.
Blake Mfg. Co., Geo. F., New York.
Buffalo Gear & Pattern Wks., Buffalo.
Caldwell & Son Co., H. W., Chicago.
Fawcus Machine Co., Pittsburg.
Ganschow, Wm., Chicago.
Jeffrey Mfg. Co., Columbus.
New Process Rawhide Co., Syracuse.
Nuttall Co., R. D., Pittsburg.
Poole Eng'g & Mch. Co., Baltimore.
Sellers Co., Inc., Wm., Phila.
Stow Flexible Shaft Co., Phila.
Wetherill & Co., Robt., Chester, Pa.

### General Water Damage Insurance.

Maryland Casualty Co., Baltimore.

### Generating Sets.

Browning Engineering Co., Cleveland.
Buffalo Forge Co., Buffalo.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.

### Gold Dredging Machinery.

Bucyrus Co., So. Milwaukee.
Risdon Iron Works, San Francisco.

### Graphite.

Dixon Crucible Co., Jos., Jersey City.
Obermayer Co., S., Cincinnati.
U. S. Graphite Co., Saginaw, Mich.

### Grates, Traveling Link.

Green Engineering Co., Chicago.

### Grease Extractors.

Beggs & Co., James, New York.

### Grinding Machinery.

Hisey-Wolf Machine Co., Cincinnati.
Western Electric Co., Chicago.

### Grinding & Polishing Mchy.

Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Clarke, Jr., & Co., Jas., Louisville.
Crocker-Wheeler Co., Ampere, N. J.
Helwig Mfg. Co., St. Paul.
Landis Tool Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison.
Pratt & Whitney Co., Hartford.
Sellers Co., Inc., William, Phila.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

### Grinding & Pulverizing Mchy.

Bradley Pulverizer Co., Boston.
Dunning, W. D., Syracuse.
Lehigh Car Wheel & Axle Works, Catasauqua, Pa.
Smidth & Co., F. L., New York.
Vulcan Iron Wks., Wilkes-Barre, Pa.

### Grinding Wheels (Alundum).

Norton Co., Worcester, Mass.

### Hack Saws.

Niles-Bement-Pond Co., New York.

### Hammers, Electric.

Helwig Mfg. Co., St. Paul.
Northern Elec. Mfg. Co., Madison.

### Heating and Ventilating Apparatus.

American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Exeter Machine Wks., Exeter, N. H.
Manning, Maxwell & Moore, N. Y.
Ohio Blower Co., Cleveland.
Stewart Heater Co., Buffalo.
Sturtevant Co., B. F., Hyde Park, Mass.
Walworth Mfg. Co., Boston.
Webster & Co., Warren, Camden, N. J.
Western Electric Co., Chicago.
Wing Mfg. Co., L. J., New York.

### High Speed Steel.

Bethlehem Steel Co., So. Bethlehem, Pa.

### Hoisting Engines and Mchy.

Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
Contractors' Plant Mfg. Co., Buffalo.
Contractors' Supply & Equip. Co., Chicago.

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Dobbie Foundry & Machine Co., Niagara Falls.
Flory Mfg. Co., S., Bangor, Pa.
Hayward Co., New York.
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.
Lambert Hoist. Eng. Co., Newark.
Lane Bros. Co., Poughkeepsie, N. Y.
Lidgerwood Mfg. Co., New York.
Link-Belt Co., Phila.
Mead-Morrison Mfg. Co., Boston.
National Equipment Co., Chicago.
Providence Eng'g Wks., Providence.
Robins Conveying Belt Co., N. Y.
Sellers Co., Wm., Inc., Phila.
Sullivan Machinery Co., Chicago.
Trenton Iron Co., Trenton, N. J.
Vulcan Iron Wks., Wilkes-Barre, Pa.
Western Electric Co., Chicago.

## Hoisting Rope.

American Mfg. Co., New York.

## Hollow Concrete Building Block Machines.

Century Cement Machine Co., Rochester.

## Hose.

Boston Belting Co., Boston.
Chicago Pneu. Tool Co., Chicago.
Eureka Fire Hose Co., New York.

## Hydraulic Gauges.

Amer. Steam Gauge & Valve Mfg. Co., Boston.

## Hydraulic Machinery.

Goulds Mfg. Co., Seneca Falls, N. Y.
Kingsford Foundry & Machine Wks., Oswego, N. Y.
Niles-Bement-Pond Co., New York.
Platt Iron Works, Dayton, Ohio.
Williams, White & Co., Moline.

## Hydraulic Rams.

Pelton Water Wheel Co., San Francisco.
Power Specialty Co., New York.

## Ice-Mak'g & Refriger. Mchy.

De La Vergne Machine Co., N. Y.
Roelker, H. B., New York.

## India Oil Stones.

Norton Co., Worcester, Mass.

## Indicators.

Amer. Steam Gauge & Valve Mfg. Co., Boston.
Ashcroft Mfg. Co., New York.
Standard Gauge Mfg. Co., Syracuse.

## Industrial Methods.

Baker-Vawter Co., Chicago.
Cooper & Co., John A., Chicago.
Gunn, Richards & Co., New York.
Pentlarge, Th., New York.
Williams & Staff, Stephen T., N. Y.

## Injectors.

Beggs & Co., James, New York.
Lunkenheimer Co., Cincinnati.

## Insurance.

Fidelity & Casualty Co., New York.
Maryland Casualty Co., Baltimore.

## Internal Gearing.

Ganschow, Wm., Chicago.
Nuttall Co., R. D., Pittsburg.

## Iron and Bronze, Ornamental.

Tyler Co., W. S., Cleveland.

## Iron and Steel Tubular Poles.

Electric Railway Equipment Co., Cincinnati.

## Iron Window Frames and Sashes.

Voigtmann & Co., Chicago.

## Jacks, Hydraulic.

Watson-Stillman Co., New York.

## Kiln.

Vulcan Iron Wks., Wilkes-Barre, Pa.

## Lamps, Electric.

General Electric Co., New York.
Sawyer-Man Elec. Co., Pittsburg.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.

## Lathes.

Am. Tool & Mch. Co., Boston.
Am. Tool Works Co., Cincinnati.
Barnes Co., W. F. & J., Rockford, Ill.
Jones & Lamson Mch. Co., Springfield, Vt.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Sellers Co., Wm., Inc., Phila.
Tindell-Morris Co., Eddystone, Pa.

## Lift Bridges.

Cowing Engineering Co., Cleveland.
Fawcus Machine Co., Pittsburg.
Scherzer Rolling Lift Bridge Co., Chicago.

## Lifting Magnets.

Browning Engineering Co., Cleveland.
Elec. Controller & Supply Co., Cleveland.

## Light Railways.

Hunt Co., C. W., New York.
Link-Belt Co., Phila.
Robins Conveying Belt Co., N. Y.

## Line Materials, Electric.

Electric Railway Equipment Co., Cincinnati.

## Locomotive Cranes.

Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
Interstate Eng'g Co., Cleveland.
Mead-Morrison Mfg. Co., Boston.
National Equipment Co., Chicago.

## Locomotives.

American Locomotive Co., New York.
Baldwin Locomotive Wks., Phila.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.
Lima Loco & Mch. Co., Lima, O.
Vulcan Iron Wks., Wilkes-Barre, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg.

## Logging Machinery.

National Equipment Co., Chicago.

## Loose Leaf Accounting Forms.

Baker-Vawter Co., Chicago.

## Lubricants.

Dixon Crucible Co., Jos., Jersey City.
Obermayer Co., S., Cincinnati.
U. S. Graphite Co., Saginaw, Mich.

## Lubricating Graphite.

U. S. Graphite Co., Saginaw, Mich.

## Lubricating & Oiling Devices.

Lunkenheimer Co., Cincinnati.
Powell Co., Wm., Cincinnati.

## Lubricators.

Greene, Tweed & Co., New York.
Lunkenheimer Co., Cincinnati.
Powell Co., Wm., Cincinnati.
Williams Valve Co., D. T., Cincinnati.

## Machinery Exhibits.

Bourse, Philadelphia.

## Machinery, Second Hand.

Niles-Bement-Pond Co., New York.

## Machinists' Small Tools.

Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford.
Sellers Co., William, Inc., Phila.

## Measuring Tapes.

Keuffel & Esser Co., New York.
Kolesch & Co., New York.
Lufkin Rule Co., Saginaw, Mich.

## Metal, Expanded.

Associated Expanded Metal Cos., New York.

## Metal Lath.

Roebling Construction Co., N. Y.

## Metaline.

North American Metaline Co., Long Island City, N. Y.

## Meters, Electric.

General Electric Co., New York.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Weston Elec. Inst. Co., Waverly Park, Newark, N. J.

## Milling Machines.

Adams Co., Dubuque, Iowa.
Becker-Brainard Mill. Mch. Co., Hyde Park, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

## Mill Supplies.

Lunkenheimer Co., Cincinnati.
Robins Conveying Belt Co., N. Y.

## Mine Cars.

Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.

## Mining Machinery.

Bradley Pulverizing Co., Boston.
Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
Fawcus Machine Co., Pittsburg.
Blake Mfg. Co., Geo. F., New York.
Deane Steam Pump Co., New York.
General Electric Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., N. Y.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
McGowan Co., John H., Cincinnati.
Mead-Morrison Mfrg. Co., Boston.
Mecklenburg Iron Works, Charlotte, N. C.
Norwalk Iron Wks., So. Norwalk, Ct.
Platt Iron Works, Dayton, O.
Power Specialty Co., New York.
Providence Eng'g Wks., Providence.
Risdon Iron Wks., San Francisco.
Robins Conveying Belt Co., N. Y.
Smidth & Co., F. L., New York.
Snow Steam Pump Wks., New York.
Sullivan Machinery Co., Chicago.
Trenton Iron Wks. Co., Trenton, N. J.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Worthington, Henry R., New York.

## Motors, Electric.

Browning Engineering Co., Cleveland.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Mfg. Co., Milwaukee.
Elec. Controller & Supply Co., Cleveland.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Lincoln Motor Wks. Co., Cleveland.
Northern Elec. Mfg. Co., Madison.
Stow Mfg. Co., Binghamton, N. Y.

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Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.

### Motor Parts.
Electric Railway Equipment Co., Cincinnati.

### Motors, Steam Turbine
De Laval Steam Turbine Co., Trenton.

### Moulding Machines.
Blake Mfg. Co., Geo. F., New York.
Obermayer Co., S., Cincinnati.
Power Specialty Co., New York.

### Name Plates.
Am. Ry. Supply Co., New York.
Murdock-Shaw Co., Boston.
Schwerdtle Stamp Co., Bridgeport.

### Naphtha Gas Machines.
Am. Gas Furnace Co., New York.

### Nickel for Nickel Steel.
Orford Copper Co., New York.

### Nozzle Piezometer Gauge.
Amer. Steam Gauge & Valve Mfg. Co., Boston.

### Office Furniture.
Globe-Wernicke Co., Cincinnati.

### Oil Burners.
Petroleum Iron Works Co., Washington, Pa.

### Oil Engines.
De La Vergne Machine Co., N. Y.

### Oil Refining Plants.
Petroleum Iron Works Co., Washington, Pa.

### Oilless Bearings.
North American Metaline Co., Long Island City, N. Y.

### Oils and Lubricants.
U. S. Graphite Co., Saginaw, Mich.

### Packing.
Boston Belting Co., Boston.
Chaplin-Fulton Mfg. Co., Pittsburg.
Jenkins Brothers, New York.
Pennsylvania Rubber Co., Jeanette, Pa.

### Paint Graphite.
Obermayer Co., S., Cincinnati.
U. S. Graphite Co., Saginaw, Mich.

### Paints and Varnishes.
Dixon Crucible Co., Jos., Jersey City.
U. S. Graphite Co., Saginaw, Mich.

### Paper, Drawing.
Mittineague Paper Co., Mittineague, Mass.

### Paper-Mill Machinery.
Blake Mfg. Co., Geo. F., New York.
Deane Steam Pump Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Jeffrey Mfg. Co., Columbus.
Keyes & Son, F. E., New York.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Robins Conveying Belt Co., N. Y.
Snow Steam Pump Wks., New York.
Worthington, Henry R., New York.

### Patent Attorneys.
Dieterich, C. A., New York.
Evans, Wilkins & Co., Washington, D. C.
Weeks, Edw. M., Washington, D. C.

### Pattern-Makers' Machinery.
Fay & Egan Co., Cincinnati.
Pratt & Whitney Co., Hartford.

### Pattern Makers.
Buffalo Gear & Pattern Wks., Buffalo.

### Penstocks.
Atlantic Works, East Boston, Mass.
Petroleum Iron Works Co., Washington, Pa.
Walsh's Holyoke Steam Boiler Co., Holyoke, Mass.

### Perforated Metal.
Caldwell & Son Co., H. W., Chicago.
Hendrick Mfg. Co., Carbondale, Pa.

### Phosphor Bronze.
Lunkenheimer Co., Cincinnati.
Phosphor Bronze Smelt. Co., Phila.
Poole Eng'g & Mch. Co., Baltimore.

### Piles, Concrete.
Raymond Concrete Pile Co., Chicago.

### Pile Drivers.
Bucyrus Co., So. Milwaukee.
Ingersoll-Rand Co., New York.

### Pipe.
Am. Spiral Pipe Wks., Chicago.
Koven & Bro., L. O., New York.
Lynchburg Foundry Co., Lynchburg, Va.
Pelton Water Wheel Co., Oakland, Cal.
Petroleum Iron Wks. Co., Washington, Pa.
U. S. Cast Iron Pipe & Fdy. Co., Phila.
Walworth Mfg. Co., Boston.
Whitlock Coil Pipe Co., Hartford.

### Pipe Bends.
Walworth Mfg. Co., Boston.
Whitlock Coil Pipe Co., Hartford.

### Pipe-Cutting and Threading Machines.
Armstrong Mfg. Co., Bridgeport.
Cox & Sons Co., Bridgeton, N. J.
Curtis & Curtis Co., Bridgeport, Ct.
Niles-Bement-Pond Co., New York.
Saunders' Sons, Inc., D., Yonkers.
Walworth Mfg. Co., Boston.

### Pipe—Spiral Riveted.
Amer. Spiral Pipe Wks., Chicago.

### Pipe Fittings, Cast Iron.
Amer. Spiral Pipe Wks., Chicago.
Pelton Water Wheel Co., San Francisco.
Pittsburg Valve & Fittings Co., Pittsburg.
Walworth Mfg. Co., Boston.

### Planers.
American Tool Wks. Co., Cincinnati.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

### Planing Mill Machinery.
Fay & Egan Co., Cincinnati.

### Pneumatic Tools.
Chicago Pneu. Tool Co., Chicago.
Clayton Air Compress. Wks., N. Y.
Curtis & Co. Mfg. Co., St. Louis.
Dayton Pneumatic Tool Co., Dayton.
Helwig Mfg. Co., St. Paul.
Ingersoll-Rand Co., New York.

### Poles, Iron and Steel Tubular.
Electric Railway Equipment Co., Cincinnati.

### Pop Safety Valves.
American Steam Gauge & Valve Mfg. Co., Boston.
Ashton Valve Co., Boston.
Consolidated Safety Valve Co., N. Y.
Lunkenheimer Co., Cincinnati.
Star Brass Mfg. Co., Boston.

### Portable Drilling Machines.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Star Drilling Mach. Co., Akron, O.

### Powder Mixers.
Dunning, W. D., Syracuse.

### Power Hammers.
Williams, White & Co., Moline, Ill.

### Power-Transmission Mchy.
Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
Caldwell & Son Co., H. W., Chicago.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Hayward Co., The, New York.
Jeffrey Mfg. Co., Columbus.
Link-Belt Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Mecklenburg Iron Works, Charlotte, N. C.
Morse Chain Co., Ithaca, N. Y.
Niles-Bement-Pond Co., New York.
Northern Electric Mfg. Co., Madison.
Platt Iron Works Co., Dayton.
Robins Conveying Belt Co., N. Y.
Rockwood Mfg. Co., Indianapolis.
Webster Mfg. Co., Chicago.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Wood & Co., R. D., Phila.

### Preservative, Wood.
McKinney Co., C. S., New York.

### Presses and Dies.
Curtis & Curtis Co., Bridgeport.
Niagara Mch. & Tool Wks., Buffalo.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Watson-Stillman Co., New York.
Wood & Co., R. D., Phila.

### Production Engineers.
Gulin, Richards & Co., New York.
Williams & Staff, Stephen T., N. Y.

### Prospecting Drills.
Ingersoll-Rand Co., New York.
Keystone Traction Drill Co., Beaver Falls, Pa.
Standard Diamond Drill Co., Chicago.
Star Drilling Machine Co., Akron, O.
Sullivan Machinery Co., Chicago.

### Pulleys, Shafting & Hangers.
Am. Tool & Machine Co., Boston.
Caldwell & Son Co., H. W., Chicago.
Fay & Egan Co., Cincinnati.
Jeffrey Mfg. Co., Columbus.
Poole Eng'g & Mch. Co., Baltimore.
Robins Conveying Belt Co., N. Y.
Rockwood Mfg. Co., Indianapolis.

### Pulverizing Mill.
Dunning, W. D., Syracuse.
Lehigh Car, Wheel & Axle Works, Catasauqua, Pa.
Smidth & Co., F. L., New York.
Vulcan Iron Wks., Wilkes-Barre, Pa.

### Pump Governors.
Albany Steam Trap Co., Albany.
Chaplin-Fulton Mfg. Co., Pittsburg.
Locke Regulator Co., Salem, Mass.
Mason Regulator Co., Boston.
Platt & Co., John, New York.

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### Pumps and Pumping Mchy.

Albany Steam Trap Co., Albany.
Alberger Pump Co., New York.
Ashcroft Mfg. Co., New York.
Beggs & Co., James, New York.
Blake Mfg. Co., Geo. F., New York.
Bucyrus Co., So. Milwaukee.
Buffalo Forge Co., Buffalo.
Cameron Steam Pump Wks., N. Y.
Clayton Air Compress. Wks., N. Y.
Deane Steam Pump Co., New York.
De Laval Steam Turbine Co., Trenton.
Deming Co., Salem, Ohio.
Emerson Steam Pump Co., Alexandria, Va.
Epping-Carpenter Co., Pittsburg.
Goulds Mfg. Co., Seneca Falls, N. Y.
Guild & Garrison, Brooklyn.
Hall Steam Pump Co., Pittsburg.
Holly Mfg. Co., New York.
Ingersoll-Rand Co., New York.
Kingsford Foundry & Machine Wks., Oswego, N. Y.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Lawrence Mch. Co., Lawrence, Mass.
Lawrence Pump & Engine Co., Lawrence Mass.
McGowan Co., John H., Cincinnati.
Mecklenburg Iron Works, Charlotte, N. C.
Morris Machine Wks., Baldwinsville, N. Y.
Platt Iron Works Co., Dayton.
Platt & Co., John, New York.
Providence Eng'g Wks., Providence.
Snow Steam Pump Wks., New York.
Southwark Fdy. & Mch. Co., Phila.
Watson-Stillman Co., New York.
Wetherill & Co., Robt., Chester, Pa.
Wheeler Condenser & Eng'g Co., N. Y.
Wood & Co., R. D., Phila.
Worthington, Henry R., New York.

### Pumps, Syphon.

Chaplin-Fulton Mfg. Co., Pittsburg.

### Pump Pressure Regulator.

D'Este Co., Julian, Boston.
Locke Regulator Co., Salem, Mass.
Mason Regulator Co., Boston.

### Punching & Shearing Mchy.

Buffalo Forge Co., Buffalo.
Morgan Construction Co., Worcester.
Niagara Mch. & Tool Wks., Buffalo.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Williams, White & Co., Moline.
Wood & Co., R. D., Phila.

### Pyrometers.

Amer. Steam Gauge & Valve Mfg. Co., Boston.
Bristol, Wm. H., New York.
Engelhard, Charles, New York.
Schaeffer & Budenberg Mfg. Co., Foxboro, Mass.
Uehling Instrument Co., Passaic,

### Quarry Machinery.

Brown Hoisting Mchy. Co., Cleveland.
Browning Engineering Co., Cleveland.
Flory Mfg. Co., S., Bangor, Pa.
Ingersoll-Rand Co., New York.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
McGowan Co., John H., Cincinnati.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Star Drilling Machine Co., Akron, O.
Sullivan Machinery Co., Chicago.
Trenton Iron Co., Trenton.

### Quartz Glass.

Engelhard, Charles, New York.

### Racks—Machine Cut.

Ganschow, Wm., Chicago.
Nuttall Co., R. D., Pittsburg.

### Rail Braces.

Rail Joint Co., New York.

### Rail Joints.

Rail Joint Co., New York.

### Railway Shop Machinery.

Barnes Co., W. F. & J., Rockford, Ill.
Brown Hoisting Mchy. Co., Cleveland.
Clayton Air Compress. Wks., N. Y.
Fay & Egan Co., Cincinnati.
Ganschow, William, Chicago.
Laidlaw-Dunn-Gordon Co., New York.
Niles-Bement-Pond Co., New York.
Norwalk Iron Wks., So. Norwalk, Ct.
Pratt & Whitney Co., Hartford.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.
Underwood & Co., H. B., Phila.
Williams, White & Co., Moline, Ill.

### Rawhide Gears.

Fawcus Machine Co., Pittsburg.
New Process Raw Hide Co., Syracuse.

### Reamers.

Chicago Pneu. Tool Co., Chicago.
Ingersoll-Rand Co., New York.
Pratt & Whitney Co., Hartford.

### Reinforced Concrete Steel.

American System of Reinforcing, Chicago.
Roebling Construction Co., New York.
Trussed Concrete Steel Co., Detroit.
Turner Construction Co., New York.

### Resistance Banks and Units.

Elec. Controller & Supply Co., Cleveland.

### Rheostats.

Simplex Elec. Heat. Co., Cambridge, Mass.

### Rheostat Regulator.

Mason Regulator Co., Boston.

### Riveting Machines.

Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Sellers Co., Wm., Inc., Phila.
Wood & Co., R. D., Phila.

### Rock Breakers.

Contractors' Supply & Equip. Co., Chicago.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.

### Rolling Lift Bridges.

Cowing Engineering Co., Cleveland.
Fawcus Machine Co., Pittsburg.
Scherzer Rolling Lift Bridge Co., Chicago.

### Rolling Mill Machinery.

Fawcus Machine Co., Pittsburg.
Morgan Construction Co., Worcester.
Niles-Bement-Pond Co., New York.
Poole Eng'g & Mch. Co., Baltimore.
Robins Conveying Belt Co., N. Y.
Tyler Co., W. S., Cleveland.
Wetherill & Co., Robt., Chester, Pa.

### Roofing.

Barber Asphalt Paving Co., Phila.
Barrett Mfg. Co., New York.
Bird Co., J. A. & W., Boston.
Stowell Mfg. Co., Jersey City.

### Roofing Tin.

Am. Sheet & Tin Plate Co., Pittsburg.

### Rope.

American Mfg. Co., New York.

### Rope Transmission.

American Mfg. Co., New York.
Caldwell & Son Co., H. W., Chicago.
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.
Link-Belt Co., Phila.

### Rubber Goods.

Boston Belting Co., Boston.
Jenkins Bros., New York.

### Rubbing and Sharpening Stones,

Norton Co., Worcester.

### Sand Mixers and Sifters.

Obermayer Co., S., Cincinnati.

### Sash Operating Device.

Drouve Co., G., Bridgeport, Conn.
Lord & Burnham Co., New York.

### Saw-Mill Machinery.

Curtis & Co. Mfg. Co., St. Louis.
Fay & Egan, Cincinnati.
Jeffrey Mfg. Co., Columbus.

### Saws, Hack.

Niles-Bement-Pond Co., New York.

### Scales.

Automatic Weighing Machine Co., Newark.
Buffalo Scale Co., Buffalo.
Richardson Scale Co., New York.

### Screens, Mining.

Jeffrey Mfg. Co., Columbus.
Ludlow-Saylor Wire Co., St. Louis.
Tyler Co., W. S., Cleveland.

### Screens, Rolled Slot.

Ludlow-Saylor Wire Co., St. Louis.
Tyler Co., W. S., Cleveland.

### Screw Machines.

Jones & Lamson Mch. Co., Springfield, Vt.
National-Acme Mfg. Co., Cleveland.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

### Screw Plates.

Card Mfg. Co., S. W., Mansfield, Mass.

### Separators, Pneumatic.

Sturtevant Co., B. F., Hyde Park, Mass.

### Separators, Steam and Oil.

American Tool & Mch. Co., Boston.
Austin Separator Co., Syracuse.
Davis Co., John, Chicago.
D'Este Co., Julian, Boston.
Direct Separator Co., Syracuse.
Goubert Mfg. Co., New York.
Harrison Safety Boiler Wks., Phila.
Hoppes Mfg. Co., Springfield O.
Locke Regulator Co., Salem, Mass.
Ohio Blower Co., Cleveland.
Potter Separator Co., Newburgh, N.Y.
Webster & Co., Warren, Camden,
Watson & McDaniel Co., Phila.

### Sewer Excavating Mchy.

Municipal Eng. & Contracting Co., Chicago.

### Shaft Couplings, Flexible.

Elec. Controller & Supply Co., Cleveland.

*For Alphabetical Index to Advertisers see page 11.*

### Shapers.
Am. Tool Works Co., Cincinnati.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

### Shutters (Fire).
Kinnear Mfg. Co., Columbus.

### Skylights.
Drouve Co., G., Bridgeport, Conn.

### Slushing Compound.
Warren Bros. Co., Boston.

### Smokeless Furnace.
Hawley Down Draft Furnace Co., Chicago.

### Special Machinery.
Fawcus Machine Co., Pittsburg.

### Speed Controllers.
Foster Engineering Co., Newark.

### Speed Limits.
Locke Regulator Co., Salem, Mass.

### Spiral Gears.
Nuttall Co., R. D., Pittsburg.

### Sprinkler Leakage Insurance.
Maryland Casualty Co., Baltimore.

### Stacks.
Atlantic Works, East Boston, Mass.
Petroleum Iron Works Co., Washington, Pa.
Smith & Son Co., Sam'l, Paterson.

### Stamps—Steel, Alphabets and Figures.
Schwerdtle Stamp Co., Bridgeport.

### Stamps, Time.
Automatic Time Stamp Co., Boston.

### Stand Pipes.
Petroleum Iron Works Co., Washington, Pa.
Smith & Son Co., Sam'l, Paterson.
Tippett & Wood, Phillipsburg, N. J.
Walsh's Boiler Wks., Holyoke, Mass.

### Steam Engine Indicators
American Steam Gauge & Valve Mfg. Co., Boston.
Ashcroft Mfg. Co., New York.
Star Brass Mfg. Co., Boston.
Schaeffer & Budenberg Mfg. Co., Foxboro, Mass.

### Steam Heating Supplies.
Locke Regulator Co., Salem, Mass.

### Steam-Regulat'g Appliances.
Albany Steam Trap Co., Albany.
Ashcroft Mfg. Co., New York.
Crane Co., Chicago.
D'Este Co., Julian, Boston.
Foster Engineering Co., Newark.
Harrison Safety Boiler Wks., Phila.
Jenkins Bros., New York.
Locke Regulator Co., Salem, Mass.
Lunkenheimer Co., Cincinnati.
Mason Regulator Co., Boston.
Pittsburgh Valve & Fittings Co., Pittsburgh.
Platt & Co., John, New York.
Power Specialty Co., New York.
Schaeffer & Budenberg Mfg. Co., Foxboro, Mass.
Walworth Mfg. Co., Boston.
Watson & McDaniel Co., Phila.
Williams Valve Co., D. T., Cincinnati.

### Steam Shovels.
Browning Engineering Co., Cleveland.
Bucyrus Co., Milwaukee.
Hunt Co., C. W., New York.
Marion Steam Shovel Co., Marion, O.
Mead-Morrison Mfg. Co., Boston.

### Steam Traps.
Albany Steam Trap Co., Albany.
American Blower Co., Detroit.
Ashcroft Mfg. Co., New York.
Blake Mfg. Co., Geo. F., New York.
D'Este Co., Julian, Boston.
Chaplin-Fulton Mfg. Co., Pittsburg.
Locke Regulator Co., Salem, Mass.
Ohio Blower Co., Cleveland.
Platt & Co., John, New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Walworth Mfg. Co., Boston.
Watson & McDaniel Co., Phila.
Williams Valve Co., D. T., Cincinnati.
Wright Mfg. Co., Detroit.

### Steam Fitters' Supplies.
Lunkenheimer Co., Cincinnati.

### Steam Hot Blast Apparatus.
Sturtevant Co., B. F., Hyde Park, Mass.

### Steel.
Jessop & Sons, Wm., New York.
Walworth Mfg. Co., Boston.

### Steel Balls.
American Ball Co., Providence.
U. S. Cast Iron Pipe & Fdy. Co., Phila.
Wood & Co., R. D., Phila.

### Steel Concrete Construction.
Aberthaw Construction Co., Boston.
Berlin Const'n Co., Berlin, Conn.
Curtin-Ruggles Co., New York.
Trussed Concrete Steel Co., Detroit.
Tucker & Vinton, New York.
Turner Construction Co., New York.

### Steel, High Speed.
Bethlehem Steel Co., So. Bethlehem, Pa.
Jessop & Sons, Wm., New York.

### Steel, Nickel.
Orford Copper Co., New York.

### Stencils.
Schwerdtle Stamp Co., Bridgeport.

### Stokers—Mechanical.
Babcock & Wilcox Co., New York.
Under-Feed Stoker Co., Chicago.
Westinghouse Mch. Co., Pittsburg.

### Strainers.
Emerson Steam Pump Co., Alexandria, Va.
Lunkenheimer Co., Cincinnati.

### Structural Iron Work.
Aberthaw Construction Co., Boston.
Berlin Const'n Co., Berlin, Conn.
Brown Hoisting Mchy. Co., Cleveland.
Curtin-Ruggles Co., New York.
Riter-Conley Mfg. Co., Pittsburg.
Scaife & Sons Co., Wm. B., Pittsburg.
Trussed Concrete Steel Co., Detroit.
Tucker & Vinton, New York.
Turner Construction Co., New York.

### Sugar-House Machinery.
Am. Tool & Mch. Co., Boston.
Blake Mfg. Co., Geo. F., New York.

### Superheaters.
Babcock & Wilcox Co., New York.
Parker Boiler Co., Philadelphia.
Power Specialty Co., New York.
Providence Eng'g Wks., Providence.

### Suspension Bunkers.
Berquist, A. Samuel, Brooklyn.
Parker Boiler Co., Philadelphia.

### Switchboards.
C & C Electric Co., New York.
Western Electric Co., Chicago.

### Tachometers.
Schaeffer & Budenberg Mfg. Co., Foxboro, Mass.

### Tanks.
Atlantic Works, East Boston, Mass.
Koven & Bro., L. O., New York.
Mecklenburg Iron Wks., Charlotte, N. C.
Riter-Conley Mfg. Co., Pittsburg.
Scaife & Sons Co., Wm. B., Pittsburg.
Smith & Son Co., Sam'l, Paterson.
Tippett & Wood, Phillipsburg, N. J.
Walsh's Boiler Wks., Holyoke, Mass.
Wetherill & Co., Robt., Chester, Pa.

### Taps and Dies.
Card Mfg. Co., S. W., Mansfield, Mass.
Crane Co., Chicago.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford.

### Tapes, Measuring.
Kolesch & Co., New York.
Keuffel & Esser Co., New York.
Lufkin Rule Co., Saginaw, Mich.

### Teams, Insurance.
Maryland Casualty Co., Baltimore.

### Temperature Regulators.
D'Este Co., Julian, Boston.

### Tenoning Machines.
Fay & Egan Co., Cincinnati.

### Terra Cotta Hollow Tile.
National Fire Proofing Co., Chicago.

### Thermometers.
Bristol Co., Waterbury.
Hohmann & Maurer Mfg. Co., Rochester.
Schaeffer & Budenberg Mfg. Co., Foxboro, Mass.

### Tile, Terra Cotta.
National Fire Proofing Co., Chicago.

### Tiling, Rubber.
Pennsylvania Rubber Co., Jeanetta, Pa.

### Time Checks.
Am. Ry. Supply Co., New York.
Schwerdtle Stamp Co., Bridgeport.

### Time Stamps.
Automatic Time Stamp Co., Boston.

### Tin Roofing.
Am. Sheet & Tin Plate Co., Pittsburg.

### Tracing Cloth.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.

### Traveling Link Grates.
Green Engineering Co., Chicago.

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### Trench Excavating Mchy.

Municipal Eng. & Contracting Co., Chicago.

### Trolley.

Browning Engineering Co., Cleveland.
Maris Bros., Philadelphia.

### Trucks, Commercial.

Electric Vehicle Co., Hartford.

### Tumbling Barrels.

Locke Regulator Co., Salem, Mass.

### Tumbling Mills.

Obermayer Co., S., Cincinnati.

### Turbines, Steam.

De Laval Steam Turbine Co., Trenton.
General Electric Co., Schenectady.
Westinghouse Mch. Co., Pittsburg.
Wheeler Condenser & Eng. Co., N. Y.
Wing Mfg. Co., L. J., New York.

### Turn Tables.

Mead-Morrison Mfg. Co., Boston.
Tippett & Wood, Phillipsburg, Pa.

### Turret Heads.

Almond Mfg. Co., T. R., Brooklyn.

### Turret Lathes.

American Tool & Mch. Co., Boston.
American Tool Wks. Co., Cincinnati.
Jones & Lamson Mch. Co., Springfield, Vt.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Tindell-Morris Co., Eddystone, Pa.

### Twist Drills.

Pratt & Whitney Co., Hartford.

### Underground Conduit Systems.

Gest, G. M., New York.

### Unions.

Dart Mfg. Co., E. M., Providence.

### Upsetting Machinery.

Williams, White & Co., Moline, Ill.

### Vacuum and Draft Gauges.

Bristol Co., Waterbury, Conn.
Hohmann & Maurer Mfg. Co., Rochester.

### Vacuum Pumps.

Alberger Condenser Co., New York.
Blake Mfg. Co., Geo. F., New York.
Buffalo Forge Co., Buffalo.
Clayton Air-Compres. Wks., N. Y.
Deane Steam Pump Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Guild & Garrison, Brooklyn.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
McGowan Co., John H., Cincinnati.
Platt Iron Works, Dayton, Ohio.
Snow Steam Pump Wks., New York.
Wheeler Condenser & Eng. Co., N. Y.
Worthington, Henry R., New York.

### Valves, Foot.

Emerson Steam Pump Co., Alexandria, Va.

### Valves—Gas, Steam and Water.

American Steam Gauge & Valve Mfg. Co., Boston.
Ashton Valve Co., Boston.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Chaplin-Fulton Mfg. Co., Pittsburgh.
Consolidated Safety Valve Co., N. Y.
Crane Co., Chicago.
Davis Co., John, Chicago.
D'Este Co., Julian, Boston.
Foster Eng'g Co., Newark.
Hancock Inspirator Co., N. Y.
Jenkins Bros., New York.
Locke Regulator Co., Salem, Mass.
Lunkenheimer Co., Cincinnati.
McGowan Co., John H., Cincinnati.
Manning, Maxwell & Moore, N. Y.
Mason Regulator Co., Boston.
Pittsburg Valve & Fittings Co., Pittsburg.
Ross Valve Mfg. Co., Troy.
Star Brass Mfg. Co., Boston.
Walworth Mfg. Co., Boston.
Watson & McDaniel Co., Phila.

### Valves, Reducing.

Chaplin-Fulton Mfg. Co., Pittsburg.
D'Este Co., Julian, Boston.
Locke Regulator Co., Salem, Mass.
Mason Regulator Co., Boston.
Williams Valve Co., D. T., Cincinnati.

### Ventilating Apparatus.

Bristol, Wm. H., New York.
Buffalo Forge Co., Buffalo.
Exeter Machine Wks., Exeter, N. H.
Massachusetts Fan Co., Watertown, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.
Wing Mfg. Co., L. J., New York.

### Voltmeters.

Western Electric Co., Chicago.
Weston Elec. Instrument Co., Waverly Park, Newark.

### Watches.

Howard Watch Co., Waltham, Mass.

### Watchman's Time Clocks.

Ostrander & Co., W. R., New York.
Schaeffer & Budenberg Mfg. Co., Foxboro, Mass.

### Water Meters.

Worthington, Henry R., New York.

### Waterproof Coatings.

Winslow Co., E. J., Chicago.

### Waterproof Felt.

Hydrex Felt & Eng'g Co., New York.

### Water Power Plants and Equipment.

Platt Iron Works, Dayton.

### Water Purifying Apparatus.

Harrison Safety Boiler Wks., Phila.
Keyes & Son, F. E., New York.
Scaife & Sons Co., Wm. B., Pittsburg.
Webster & Co., Warren, Camden, N. J.

### Water Softening Apparatus.

Harrison Safety Boiler Wks., Phila.
Keyes & Son, F. E., New York.
Scaife & Sons Co., Wm. B., Pittsburg.
Webster & Co., Warren, Camden, N. J.

### Water-Wheels.

Doble Co., Abner, San Francisco.
Mecklenberg Iron Wks., Charlotte, N. C.
Pelton Water Wheel Co., San Francisco.
Platt Iron Works, Dayton, Ohio.
Poole Eng'g & Mch. Co., Baltimore.
Power Specialty Co., New York.
Wood & Co., R. D., Phila.

### Water-Wheel Governors.

Lombard Governor Co., Ashland, Mass.
Woodward Governor Co., Rockford, Ill.

### Water-Works Pumping Mchy.

Buffalo Forge Co., Buffalo.
Blake Mfg. Co., Geo. F., New York.
Deane Steam Pump Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Holly Mfg. Co., New York.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Lawrence Mch. Co., Lawrence, Mass.
Platt Iron Works, Dayton, Ohio.
Snow Steam Pump Wks., New York.
Southwark Fdy. & Mch. Co., Phila.
Wetherill & Co., Robt., Chester, Pa.
Wood & Co., R. D., Phila.
Worthington, Henry R., New York.

### Water-Works Supplies.

Power Specialty Co., New York.

### Wells—Artesian.

Clayton Air Compress. Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Platt Iron Works, Dayton, Ohio.

### Well Drilling Machines.

Keystone Traction Drill Co., Beaver Falls, Pa.
Star Drilling Machine Co., Akron, O.

### Well Supplies.

Laidlaw-Dunn-Gordon Co., New York.
Star Drilling Machine Co., Akron, O.
Williams Bros., Ithaca, N. Y.

### Whistles.

Amer. Steam Gauge & Valve Mfg. Co., Boston.
Lunkenheimer Co., Cincinnati.
Schaeffer & Budenberg Mfg. Co., Foxboro, Mass.

### Window Frames, Iron and Copper.

Voigtmann & Co., Chicago.

### Window Sashes, Iron and Copper.

Voigtmann & Co., Chicago.

### Wire-Drawing Machinery.

Morgan Construction Co., Worcester.

### Wire Cloth and Screen.

Ludlow-Saylor Wire Co., St. Louis.
Tyler Co., W. S., Cleveland.

### Wire Lath.

Ludlow-Saylor Wire Co., St. Louis.
Roebling Construction Co., N. Y.

### Wire Rope.

Jeffrey Mfg. Co., Columbus.
National Equipment Co., Chicago.

### Wood Blocks.

U. S. Wood Preserving Co., New York.

### Wood Preservative.

McKinney Co., C. S., New York.

### Wood-Working Machinery.

Chicago Pneumatic Tool Co., Chicago.
Fay & Egan Co., Cincinnati.
Ingersoll-Rand Co., New York.

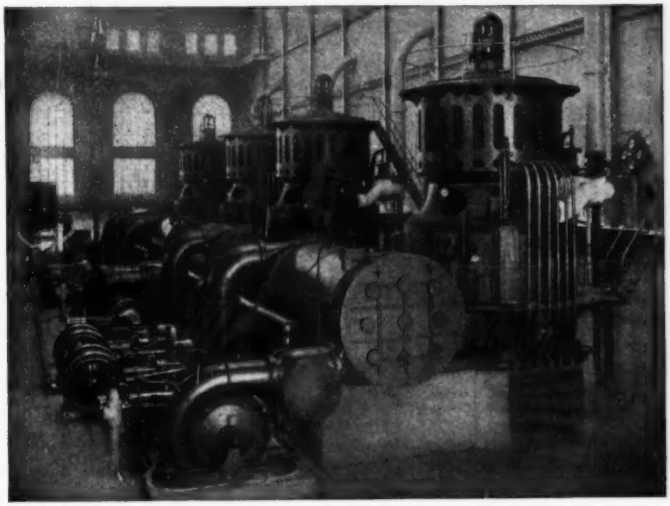
### Worm Gearing.

Fawcus Machine Co., Pitsburg.
Ganschow, William, Pittsburg.
Nuttall Co., R. D., Pittsburg.

*For Alphabetical Index to Advertisers see page 11.*

# General Electric Company

## Curtis Turbines are used
### where requirements are exacting



Interior of Port Morris Power Station, showing four 5,000 kw. Curtis Turbine Generators. This installation is duplicated in the Yonkers Power Station and forms one-half of the generating capacity installed in the electrification of the New York terminal of the New York Central Lines.

Curtis Turbine Generators perform the most exacting service in the conversion of 80,000 horse-power from steam to traction in the largest and most notable steam railroad electrification ever undertaken.

**Service of this kind demands absolute certainty of operation**

**Send for Catalog No. 9131-M, telling more about them**

1311

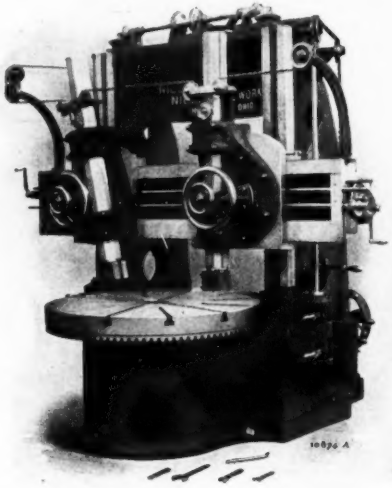
**New York Office:** 44 Broad St.

**Principal Office:** Schenectady, N. Y.

**Sales Offices in all large cities**

**NILES ELECTRIC TRAVELING CRANES 2 to 200 TONS CAPACITY**

Write for new Crane Catalogue



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**BEMENT HAMMERS**

**HYDRAULIC MACHINERY**

Catalogues promptly furnished

**NILES-BEMENT-POND COMPANY**

**111 Broadway, New York**

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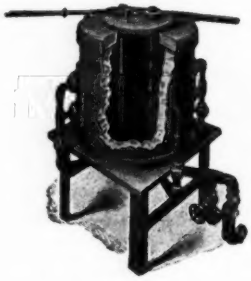


**IT'S WASTED ECONOMY.**

To risk the hardening of High Speed Tools in a furnace you have to "keep guessing" as to what the outcome will be. High Speed Tools require High Grade methods. Users of the new alloy steel will find our machines adapted to the requirements of the modern steels. No overheating, cracking, warping, scaling or distorting. We build machines in many shapes. Our Catalogue shows them all.

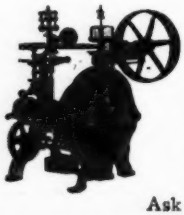
This is

**CYLINDRICAL HARDENING FURNACE NO. 12.**

For hardening Reamers, Taps, Drills, etc. Thoroughly described in "Supplement 2."

**American Gas Furnace Company,**

23 John Street NEW YORK



**WOODWARD WATER-WHEEL GOVERNORS**

Are complete in themselves. No pumps or electric current required. The regulation is right and the price is right.

Ask for our Catalogue.

**WOODWARD GOVERNOR CO.**

658 Race St., Rockford, Ill.

**"EVERYTHING FOR BLUE PRINTING"**
**Send for Circulars**

Automatic Electric Blue Printers
Continuous Electric Blue Printers
Blue Print Washing and Drying Machines

**C. F. PEASE**
**BLUE PRINT MACHINERY & SUPPLY CO.**
**G-22 Fifth Ave., Chicago**

**AUTOMOBILES**

Consult the Engineering Index in this Magazine for numerous valuable papers on Automobiles.

"AMERICAN"

# Rope Transmission

*vs*

# Electrical Transmission

*I.---Cost of Installation.*

To support our widely advanced claim for the superior efficiency of "American" Transmission Rope over any other known means for the transmission of power, we make the following emphatic offer:

"The American Manufacturing Co., of 65 Wall Street, New York City, will agree to furnish the necessary rope sheaves, rope and driven head shafts for the main drives of any cotton or similar mill using 500 horse-power or more, developed at the mill site, at *one-quarter* the price for which any responsible company furnishing electrical apparatus which will agree to install electrical generators, motors, motor shafts, switchboards, wiring, and other appliances necessary to electrically transmit the same power.

"Where power is generated at a distance from the mill site, if the mill will install the central motor, the American Manufacturing Co. will agree to distribute the power from same to the main line shafts, by means of rope drives, for half the cost of the electrical apparatus to distribute the same power.

"This offer is made to any cotton, woolen, paper or similar mill in the United States.

Write for our "Blue Book on Rope Transmission."

THE AMERICAN MANUFACTURING CO.,

*Manila, Sisal and Jute Cordage*

65 WALL STREET, NEW YORK CITY

TRANSMISSION ROPE

*Please mention The Engineering Magazine when you write.*

TRADE BEST VALUE MARK

# Solving Business Problems

Where a manufactured product is made up of many different parts or materials that vary in cost with fluctuating markets, the problem of keeping an accurate record of the material cost of the finished product is a complicated one.

This is one of the difficulties always confronting the manufacturer of wire fencing and gates. Several different gauges of wire enter into the manufacture of each style of fence, differing in quantities according to the closeness of the weave, the pattern and the width of fence. Cost-keeping is further complicated by the fact that each lot of fence woven may be made up of varying sizes of wire bought at different times on different prices.

A large Illinois manufacturer of wire fence, gates, and specialties asked the Baker-Vawter Company to devise a factory-cost and office-accounting system that would solve all the problems peculiar to its rather intricate business.

PROBLEM OF WIRE COSTS.

We can only give here a general idea of the simple and effective system installed to show definitely the cost of wire entering into each factory order of fencing. All the coils included in each carload of wire received, when unloaded, are strung on one wire loop, tied and tagged with the requisition number, source, and quantity, and a serial letter indicating the base cost of the wire in the car. The letters A, B, C, etc., are used to indicate various base prices on wire, extras for lighter gauges being fixed separately, as they do not vary. Wire thus received is charged on *Available for Orders* ledger, and when delivered to the fence mill is charged to the *Set Aside for Orders* ledger. When manufactured into fence this account in turn is credited and *Fence Account* charged with the actual cost of the wire used, plus extra freight, with prorating of unloading and other fixed charges.

The movement of the wire is recorded by means of cards which move forward through *Wire in Transit* file and *Stock* file to *Consumed Stock* file.

MATERIALS OTHER THAN WIRE.

All stock purchased is delivered and charged to the storekeeper, who checks quantities received against invoices as recorded on *Accounts Payable* blanks.

Superintendents or foremen can secure stock of any kind only on a *Requisition on Storekeeper* blank, in which the proposed disposition of each class of material is given by job or lot number.

The storekeeper, on delivering the material called for, charges it at its cost price to the account numbers shown on the requisition.

These charges go each month to the cost clerk, who charges the material costs on a form provided for the purpose against each job or lot, adding the labor cost and an equitable prorating of overhead expenses, such as power, light, insurance, rent, unloading, storing, superintendence, etc.

LABOR CHARGES.

All labor is divided into two general classes, direct and indirect, and on each monthly summary the pay-roll must balance with the labor charges against the month's product of each department and each product. To these manufacturing costs are added selling costs, and the totals of these are subtracted from total sales to secure current profits. The total sales are secured from a summary of the daily sales recapitulations. A column headed "Percentage this Month," shows the percentage of each expense item to total sales for that month.

Name and address will be furnished on application to the Baker-Vawter Company by addressing either their Chicago or New York office.

TRADE BEST VALUE MARK

# THE FIDELITY AND CASUALTY CO.

## OF NEW YORK

**ASSETS, - - - - - - - - - - - - - - - $8,003,530.06**
**CAPITAL AND SURPLUS, - - - - - - - 2,904,775.76**
**LOSSES PAID TO JANUARY 1, 1907, - - 24,016,230.73**

THIS Company grants insurances as follows: Bonds of Suretyship for persons in positions of trust, Fidelity Bonds, Burglary, Plate Glass, Steam Boiler, Fly Wheel, Employers, Public Teams, Workmen's Collective, Elevator and General Liability, Personal Accident, Health and Bonded Attorneys' List.

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**Principal Offices, Nos. 97-103 Cedar Street, New York**

Agents in all considerable towns

# COMPLETE

Electrical conduit systems designed and carried out in their entirety in every part of the world

## G. M. GEST

EXPERT ELECTRICAL CONDUIT CONTRACTOR

CINCINNATI, OHIO 277 BROADWAY, N. Y. U. S. A.

AMERICAN

**ALSEN'S CEMENT**

45 BROADWAY NEW YORK

**"Facts are better than assertions"**

GERMAN

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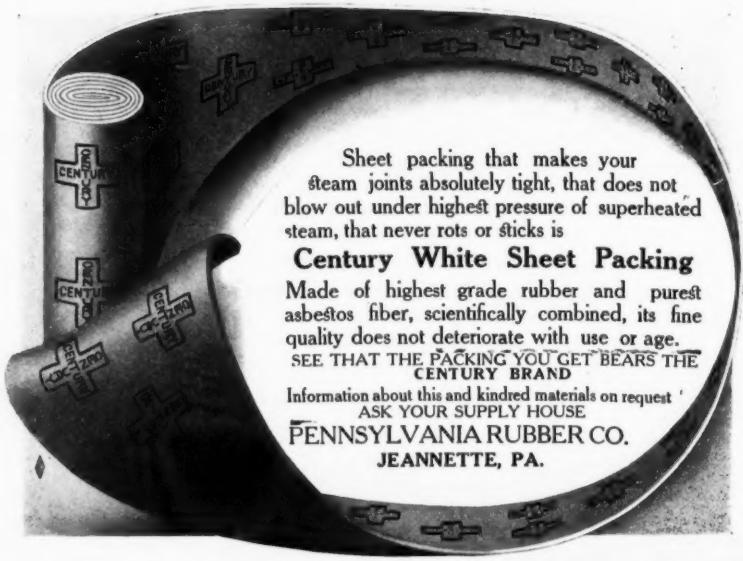


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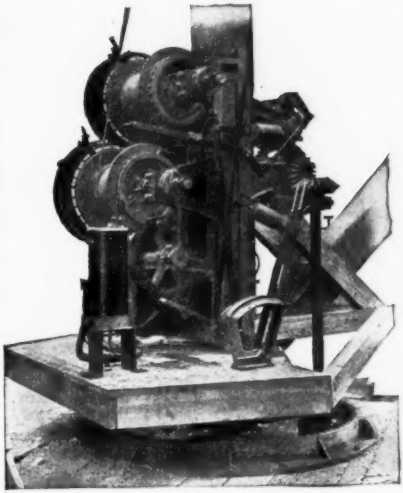

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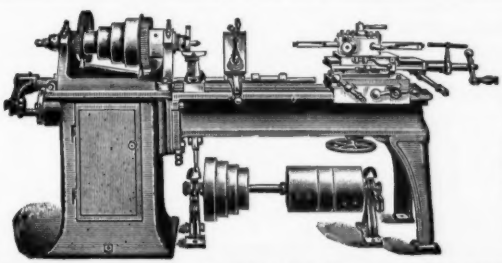

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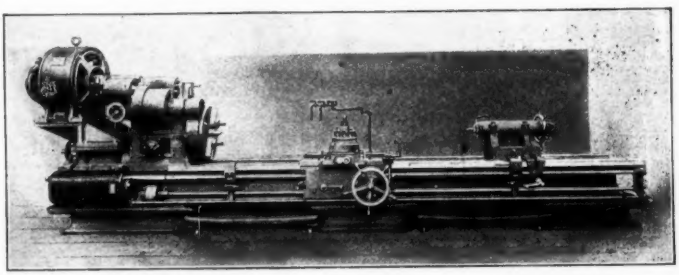

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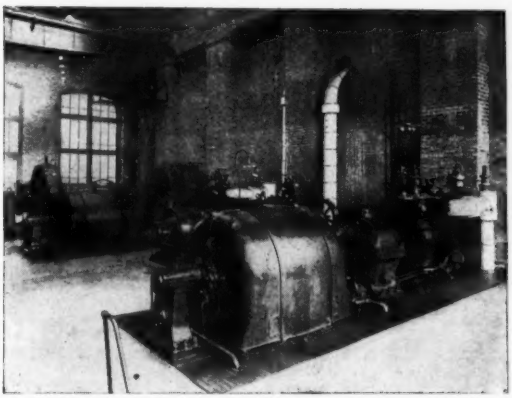

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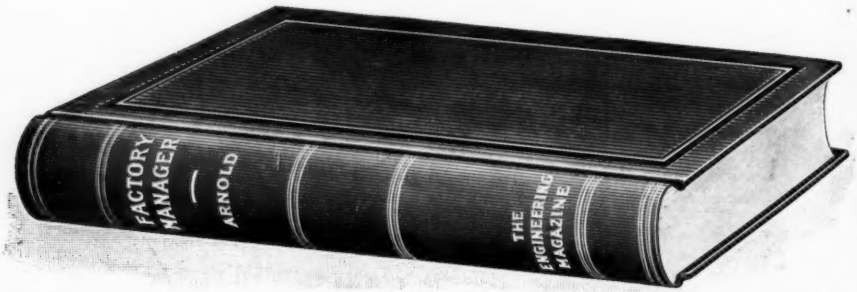


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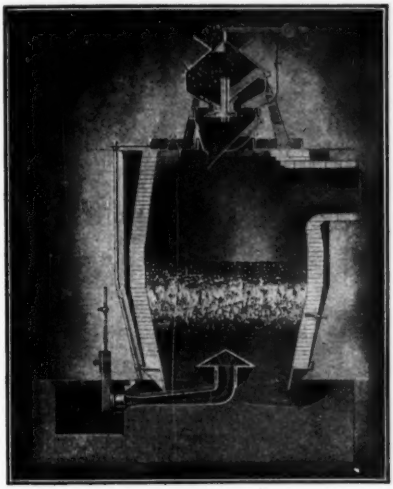

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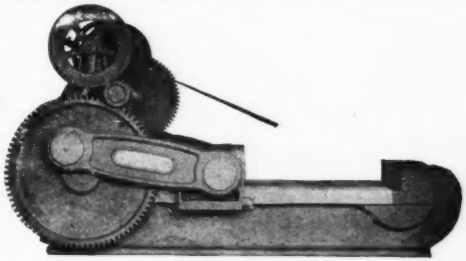

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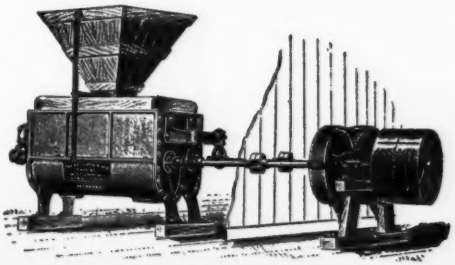

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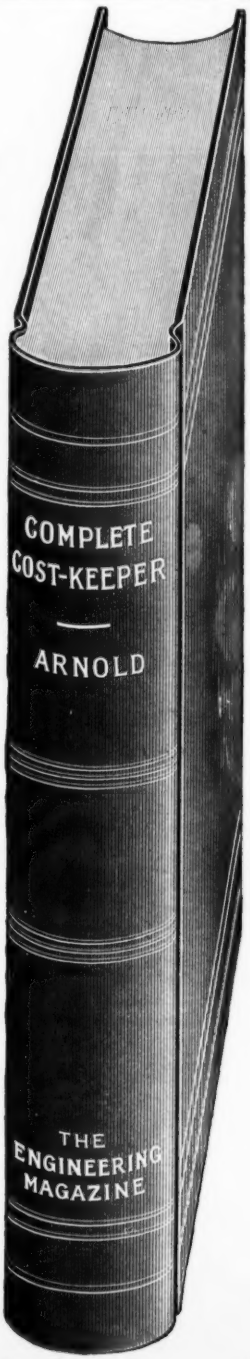


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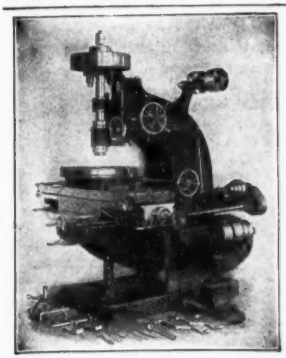

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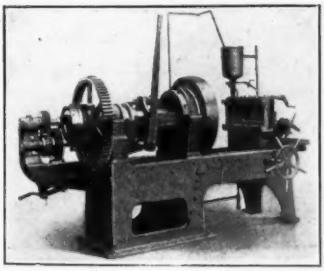

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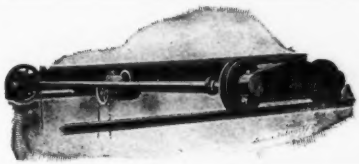

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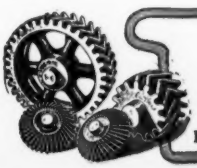

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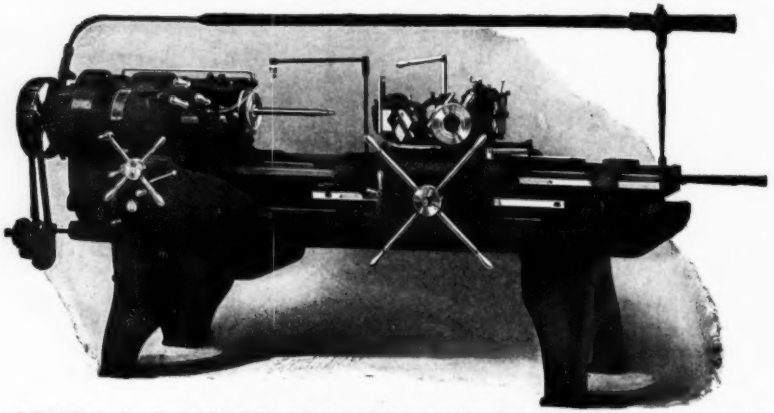

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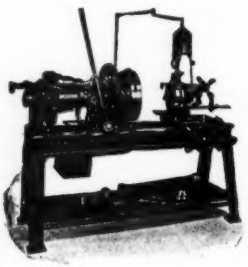

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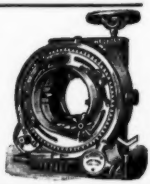

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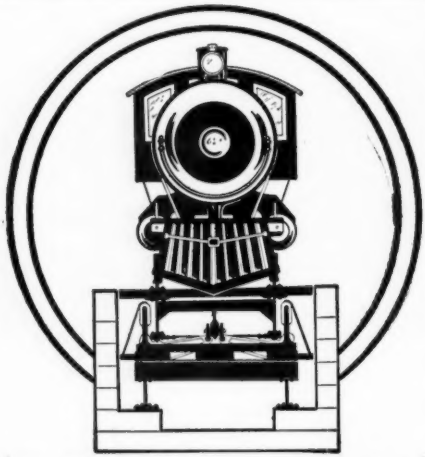

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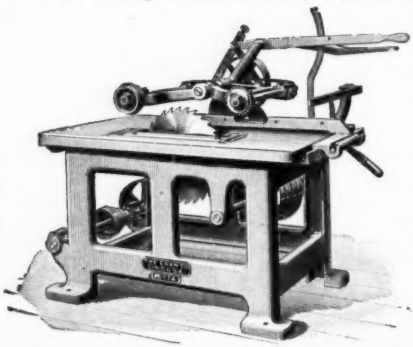

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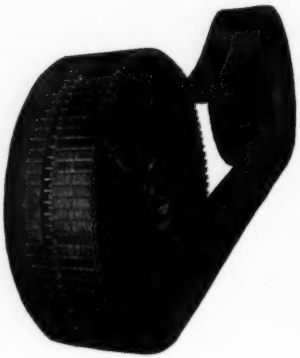

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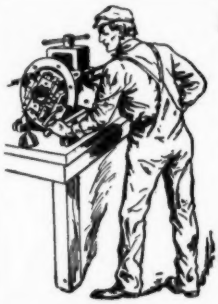

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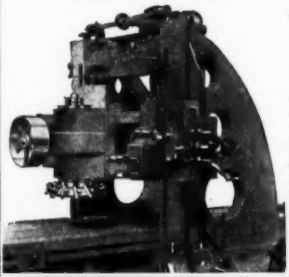

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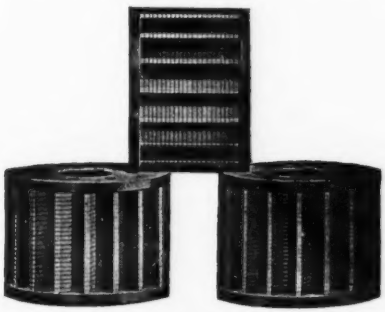

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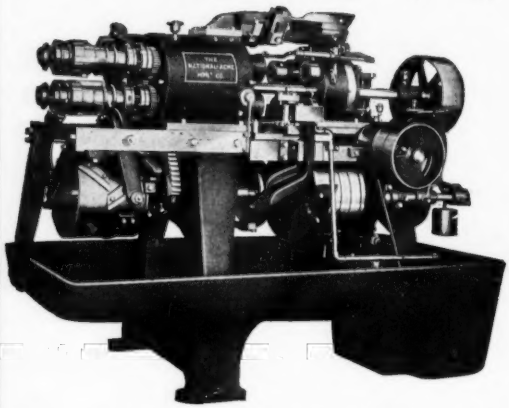

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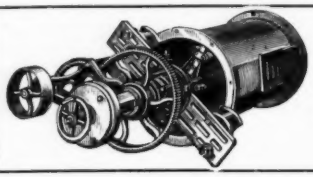

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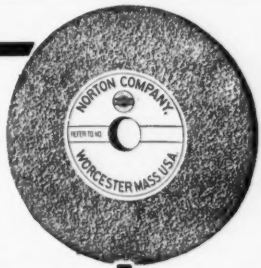


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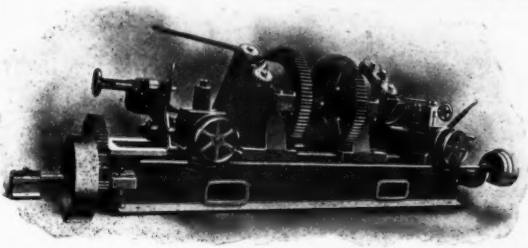

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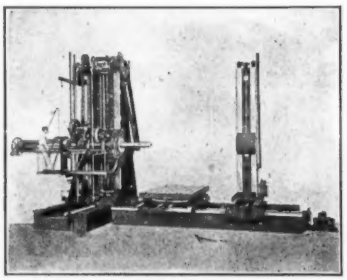

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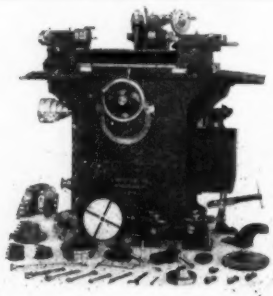

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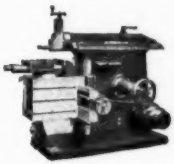

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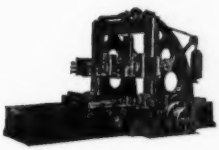

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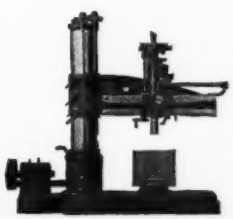

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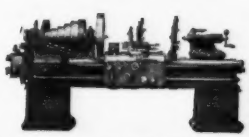

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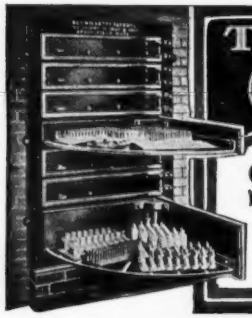

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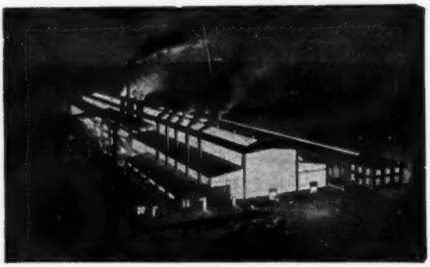

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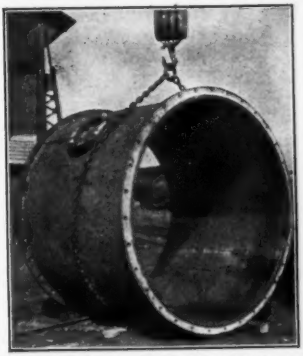

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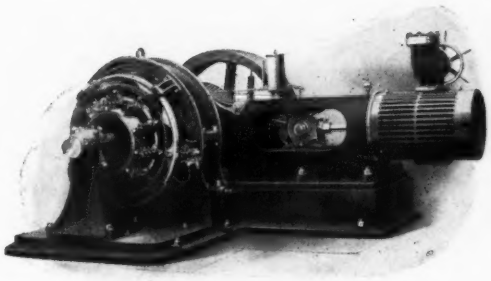

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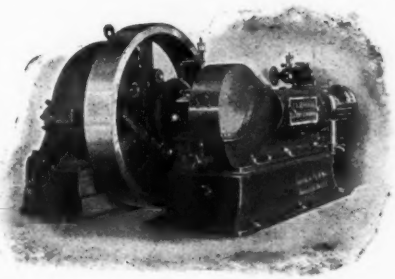

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"... For 13 years these two engines have run like chronometers, ... and we require steady work. *You can depend on these machines like the stars for faithfulness. In 5 years they have not cost the government $5 for repairs.*"

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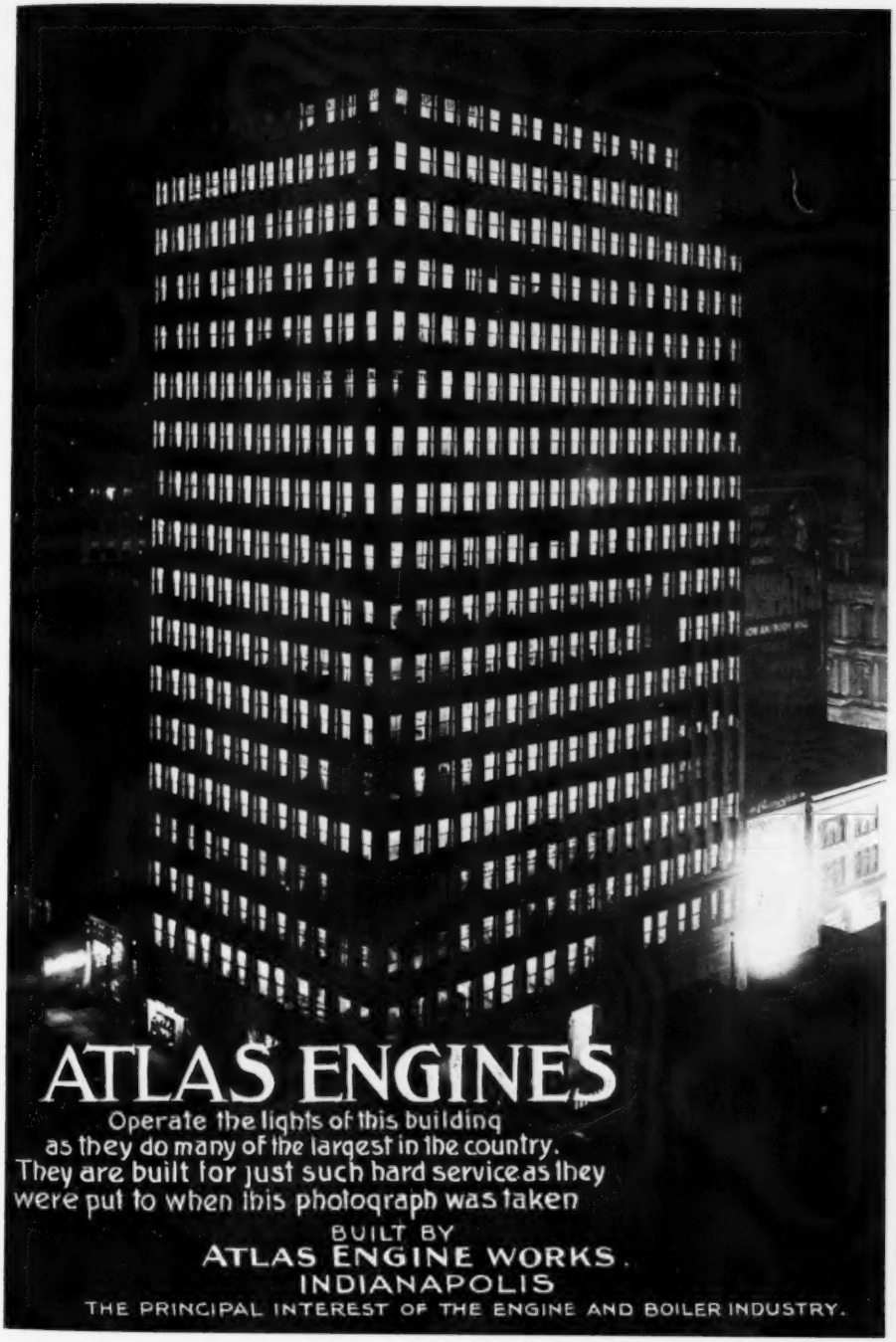
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Operate the lights of this building
as they do many of the largest in the country.
They are built for just such hard service as they
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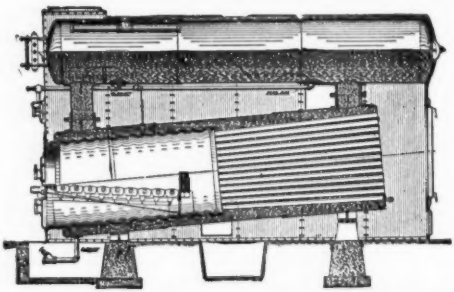

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**Built in all sizes from 60 to 250 horse power**

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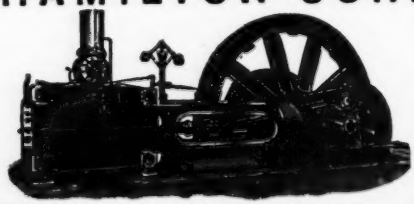

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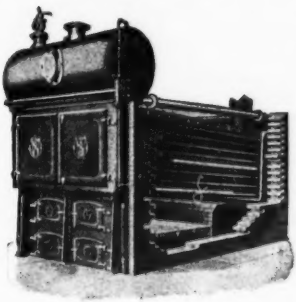

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THE requirements of a Boiler for electrical and other high duty work, in connection with modern triple and quadruple expansion, and compound engines, are:

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*Third*—The ability of a Boiler to work with economy when forced beyond its rated capacity.

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**Built in units ranging from 100 to 500 horse power**

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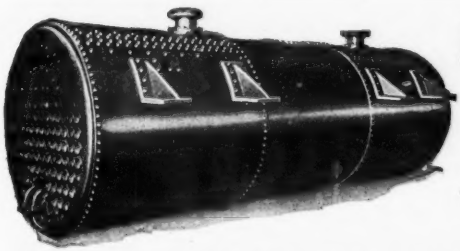

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Manufactured by

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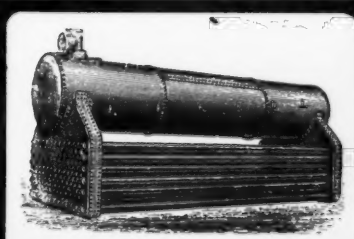

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**WATER TUBE**
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The usual guarantee with every furnace is as follows:

First, that it will save at least 15 per cent. of the coal, over plain grates.

Second, that it will give an increase of over 25 per cent. in the steam capacity, above rating, and

Third, that it will prevent 95 per cent. of the smoke when burning any grade of bituminous coal.

The Hawley Furnace consists of a water tube grate, on which the coal is fired, but the flame is drawn down, instead of up, as ordinarily.

The gases of distillation pass downwards through the fire into the lower furnace, together with the proper amount of preheated air for complete combustion.

The water tube grate and connecting piping adds heating surface to the boiler and intensifies its natural circulation, increasing efficiency.

The lower grate catches the consumed fuel which drops through the water grate, thus maintaining a high furnace temperature, burning the volatile content of the coal, and thereby preventing smoke.

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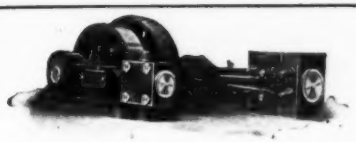

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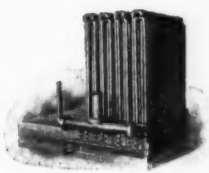

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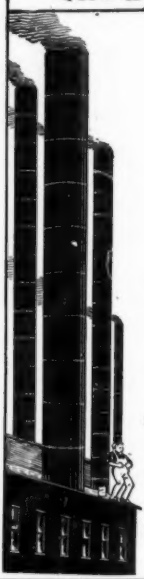

**Stop the Feast.**

Not a single Devil
Is now alive
On the stacks with
Graphite painted.

On the other stacks
They feast and thrive
And the stacks with Rust
Are tainted.

Stop that ceaseless feast
of the Rust Devils on
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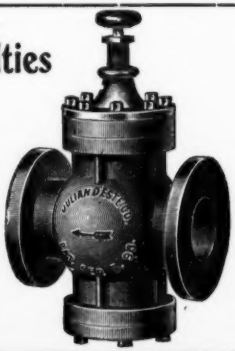


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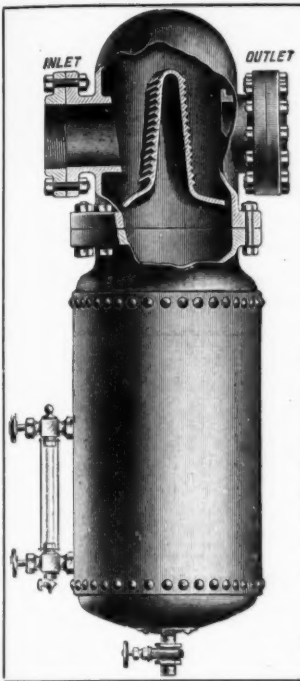


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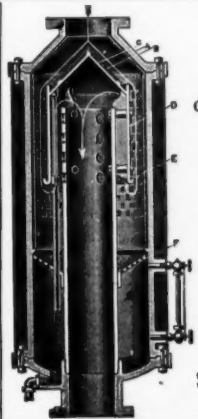

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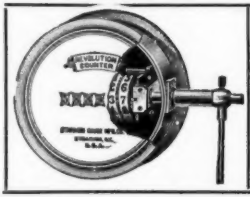

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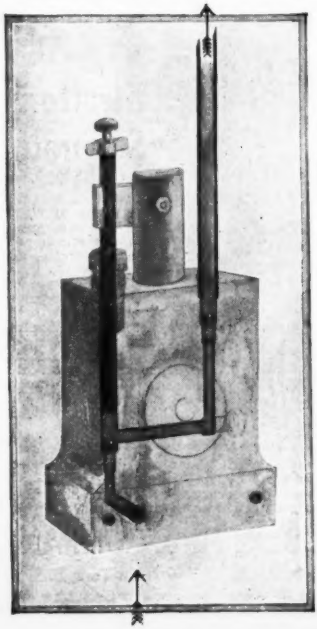

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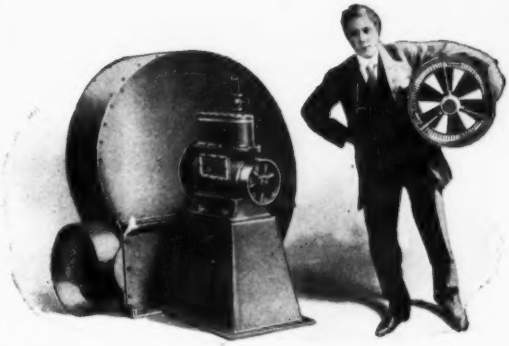

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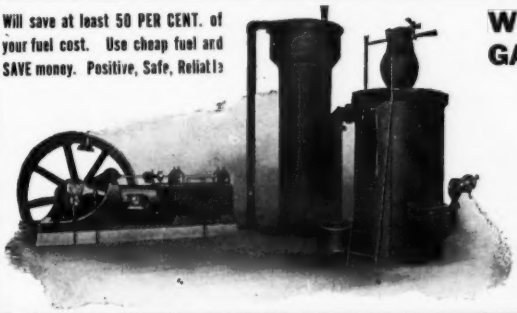

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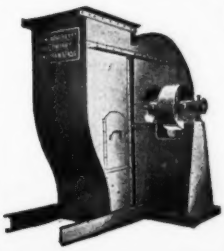

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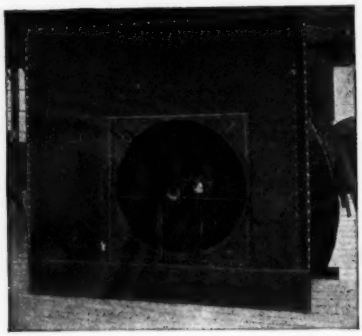

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DO NOT leave for November what you should do in September. Write us today giving full particulars in regard to your Heating and Ventilating Problem or ask us to send our engineer, who can come to your plant and carefully study the work to be done. After ascertaining the cost of power for driving and average and maximum pressures and volumes required, and after going over the proposed layout of flues and conduits, checking up calculations on temperature, humidity, etc., he will bring the data back to our engineering offices, where your heating and ventilating system will be laid out on the most economical lines. Any system of heating is incomplete and imperfect that does not provide a proper supply of air, and when it is appreciated that depleted air results in low mental and physical vitality it will be seen that the thought and time devoted to this problem will be well invested.

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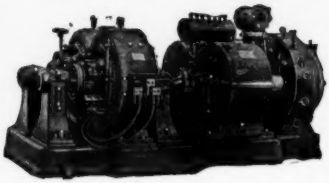

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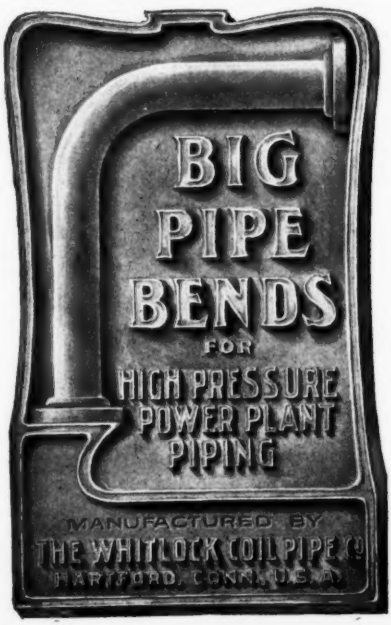



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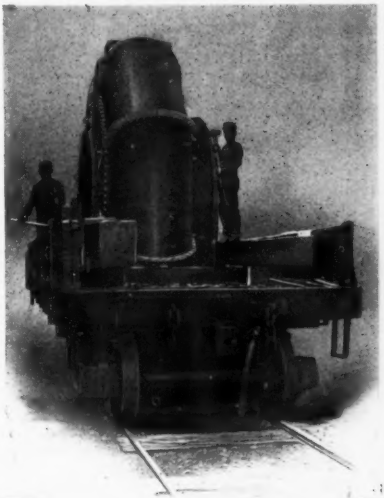

**Free Power and Boiler Feed Water in Industrial Plants**

For heating, drying, evaporating, etc., exhaust steam can generally be used in whole or in part, provided it has first been passed through a Cochrane Steam and Oil Separator. The condensed steam, as pure distilled water, can then be returned to the boilers through a Cochrane Feed Water Heater, saving not only this water, but also its heat. As exhaust steam contains from 80 to 95 per cent. of the heat of live steam, the power generated in the engines is thus obtained at practically no fuel cost.

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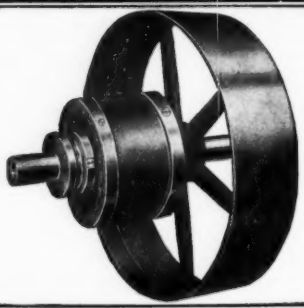

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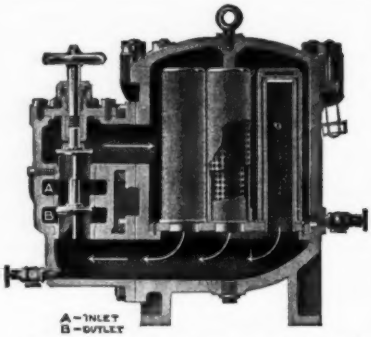


Feed the condenser water right back to the boilers. No danger from oil, if you put a

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offer the double advantage of being efficient and durable.

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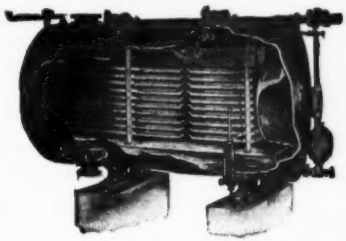

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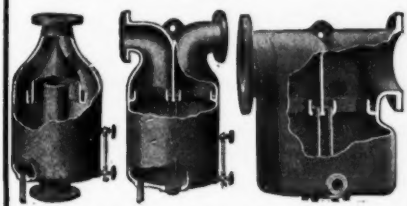

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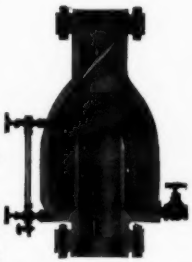

whirls the water from the steam

by centrifugal force and thus positively prevents the possibility of throttle valves bursting, flooding, shaking or vibration. The "Swartwout" Separator is tested at 400 lbs. pressure and guaranteed for 150 lbs. working pressure. There is nothing complicated in its construction and is the only process which can be depended upon to reduce risk to the minimum, and the only separator in which the steam always travels in one direction.

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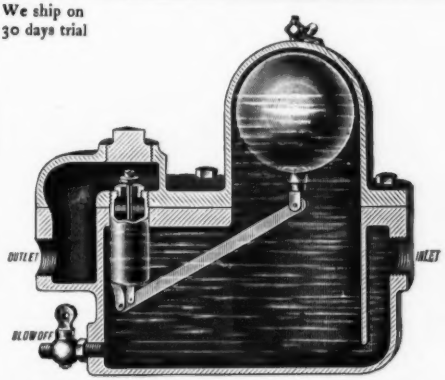


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Will discharge the accumulated condensation from steam lines automatically and instantaneously regardless of small flows or floods and is guaranteed not to waste steam in the operation. *Send for illustrated catalog.*

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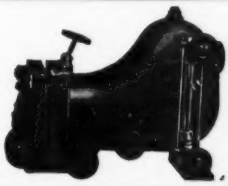

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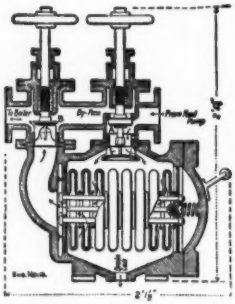
## Keep Out Oil.



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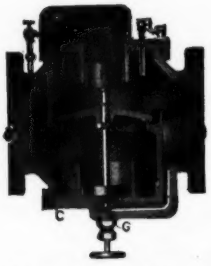

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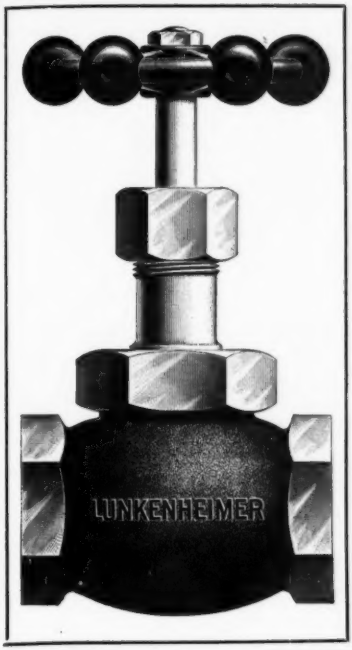


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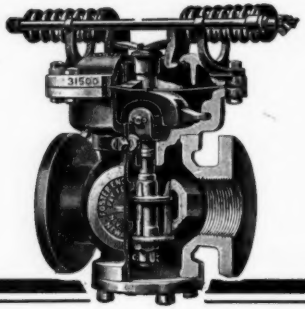

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**P XX**

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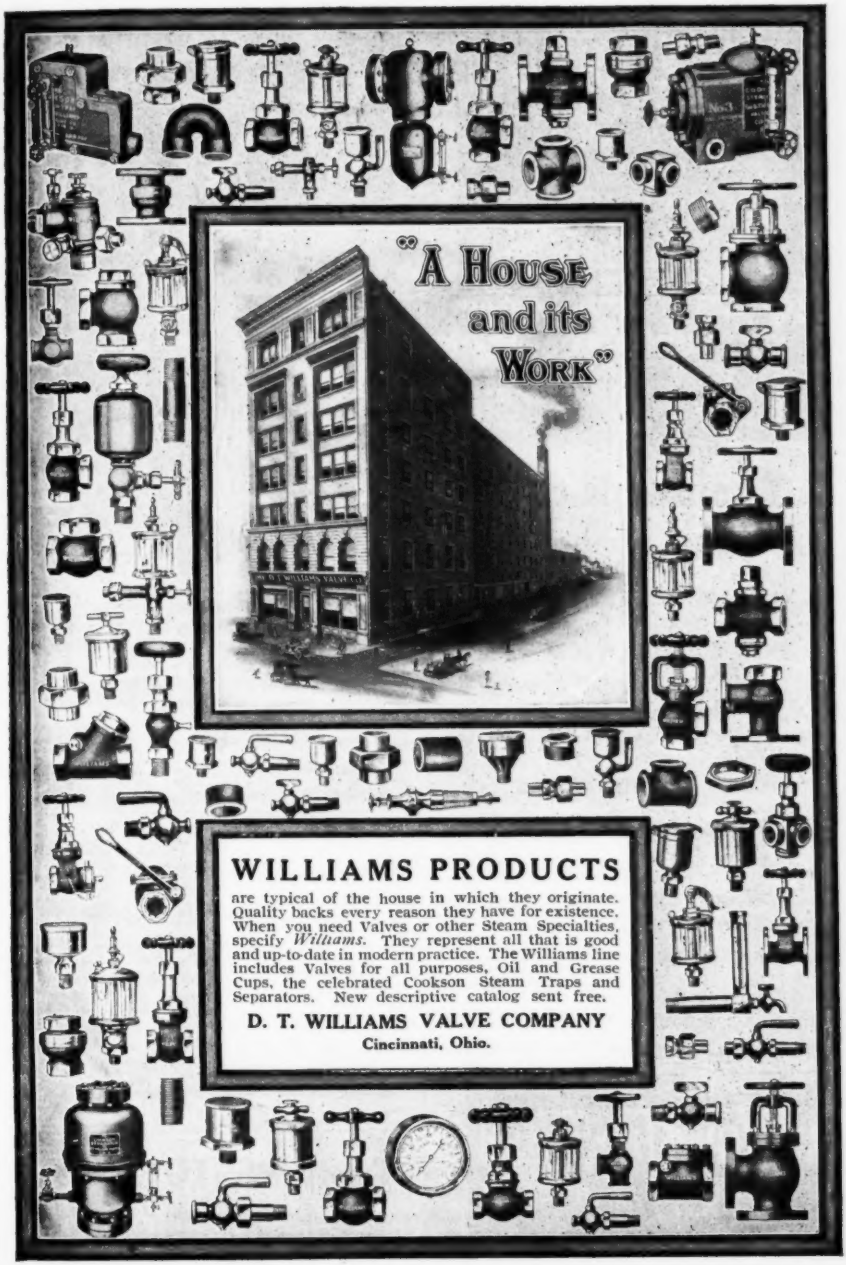
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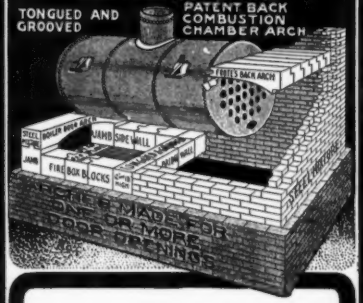

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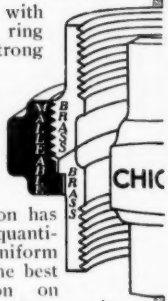


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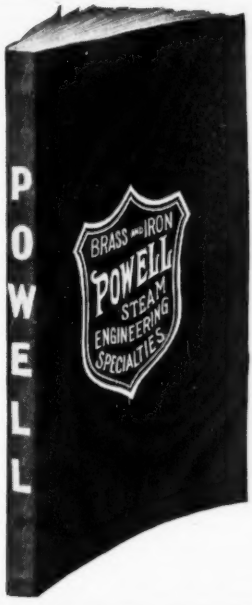


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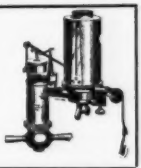

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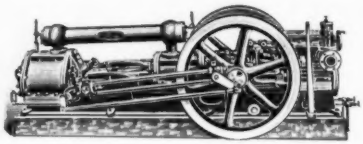

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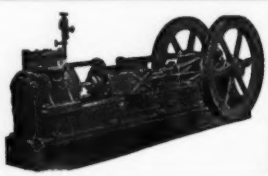

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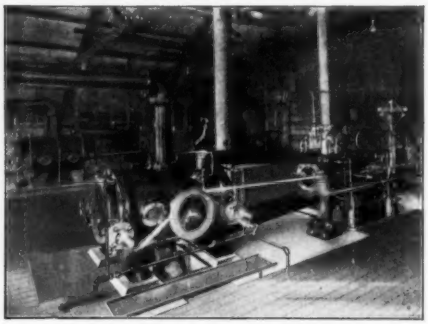
# SULLIVAN AIR COMPRESSORS



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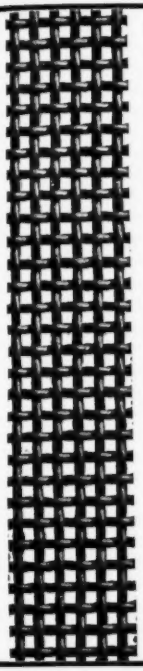

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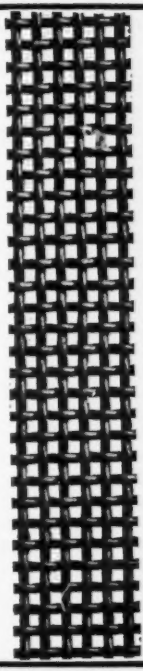

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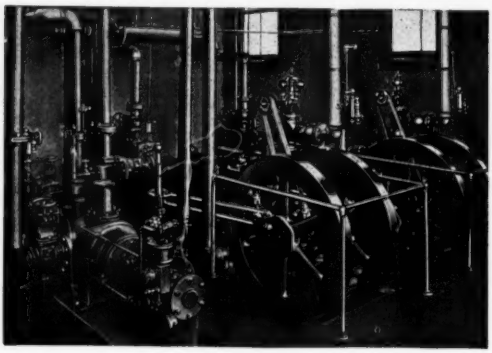
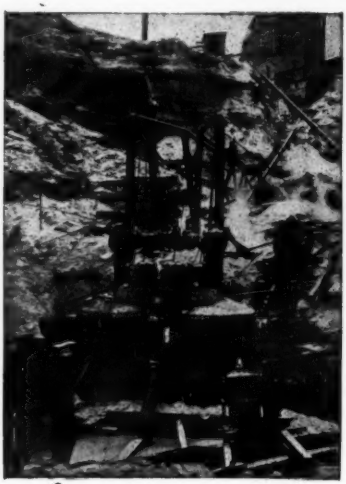


"Return-Air" Installation at the Chattanooga Furnaces of the Chattanooga Coal and Iron Co, Chattanooga, Tenn. This illustration shows the air compressor end and the automatic switch of the system.



Pumping sand with the "RETURN AIR" System in the quarries of the United States Silica Co., Ottawa, Ill. This illustration shows the tank end of the system which is usually submerged when pumping liquids.

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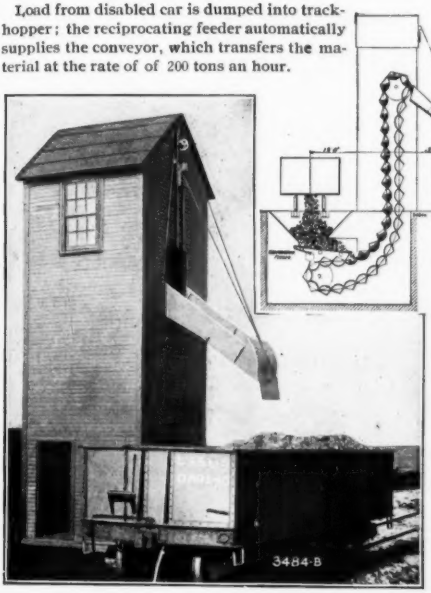
Load from disabled car is dumped into track-hopper; the reciprocating feeder automatically supplies the conveyor, which transfers the material at the rate of of 200 tons an hour.

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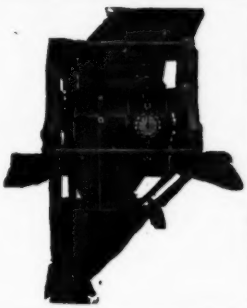

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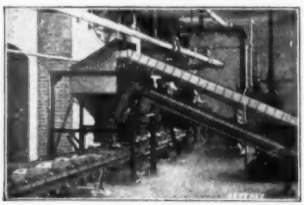

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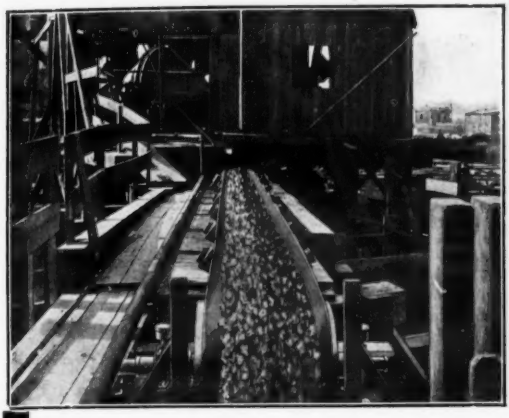

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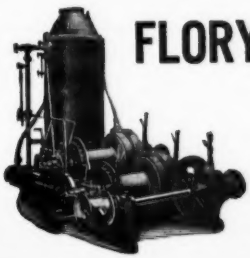

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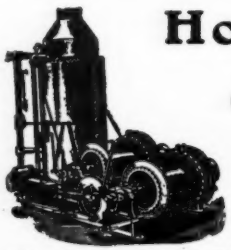

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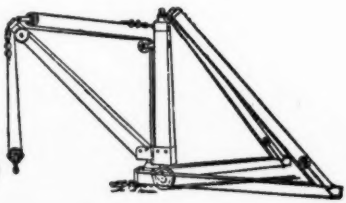

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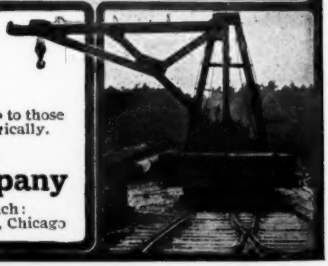

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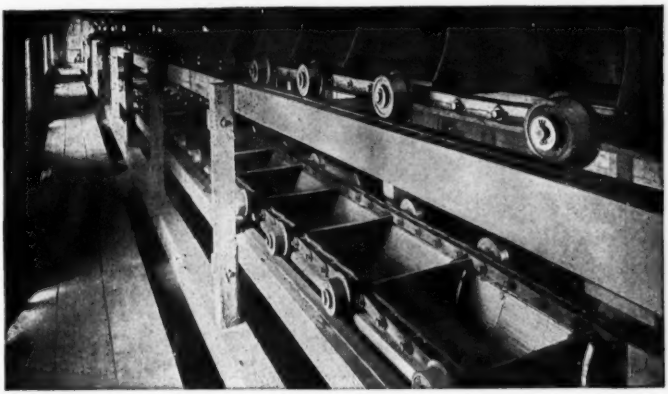

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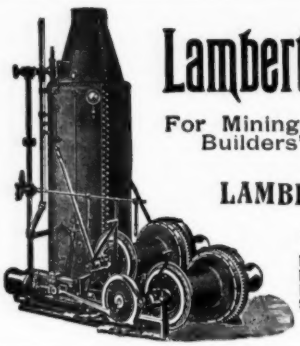

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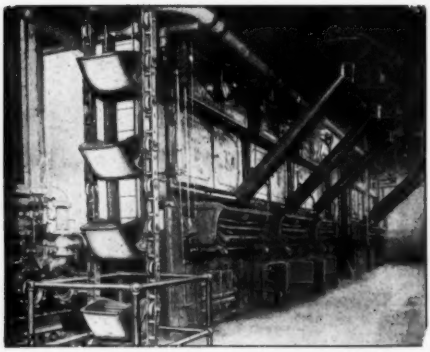

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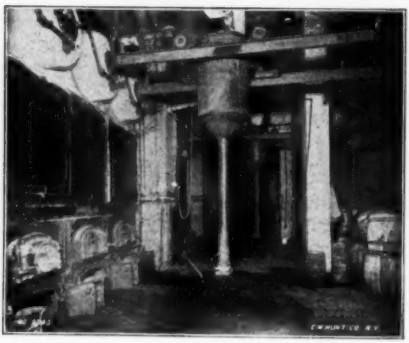

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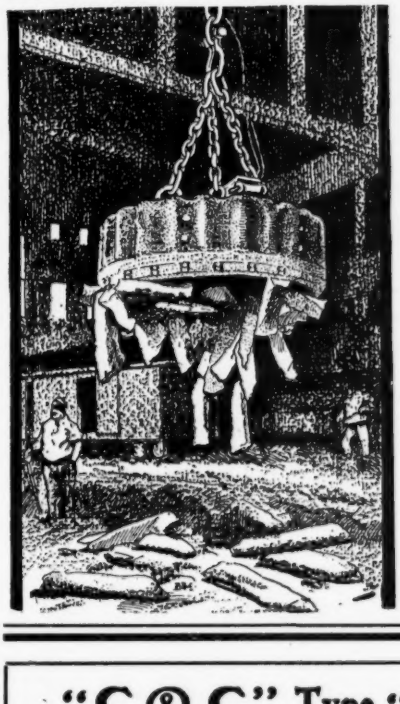

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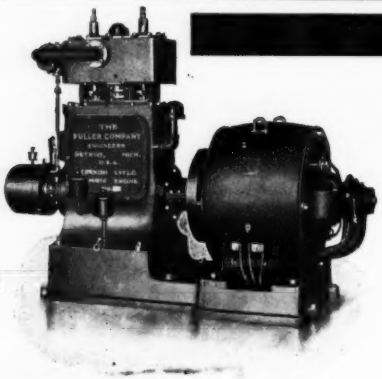

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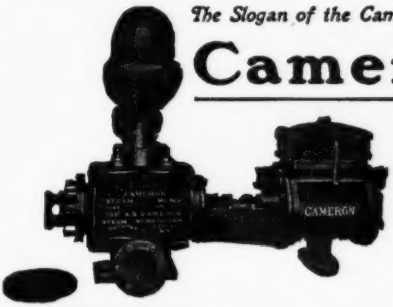


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If your water is very gritty and the use of a Plunger Pump is prohibited on account of the limited space or other circumstances, we suggest the adoption of our Piston Pump fitted with Removable Bushing of iron or composition.

This bushing can be turned in the pump so that the wear, which is usually greatest at the bottom, can be gradually distributed over every portion of its surface, thus allowing the greatest durability with this type of pump.

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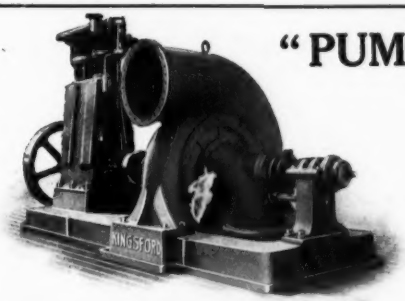


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## Centrifugal and Turbine

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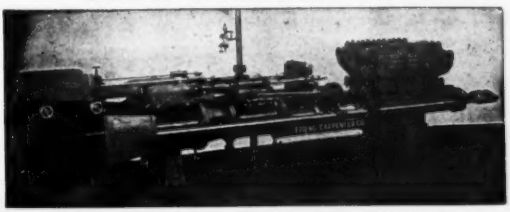
**STEAM PUMPING MACHINERY For Every Service**



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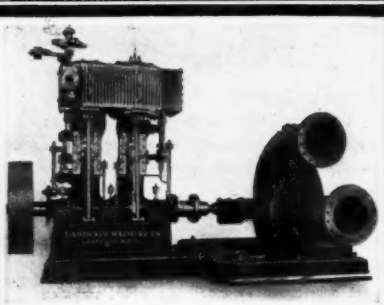

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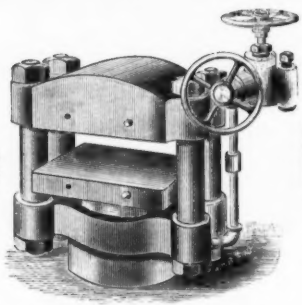
Hydraulic  Presses

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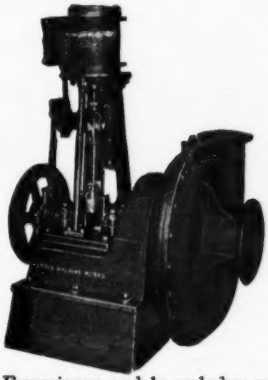

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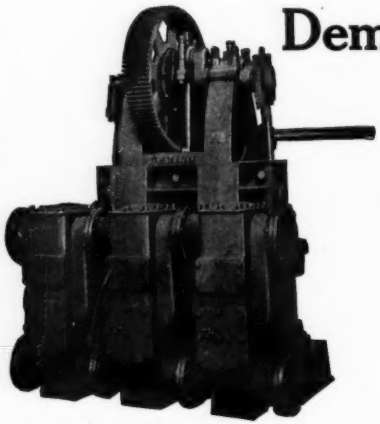

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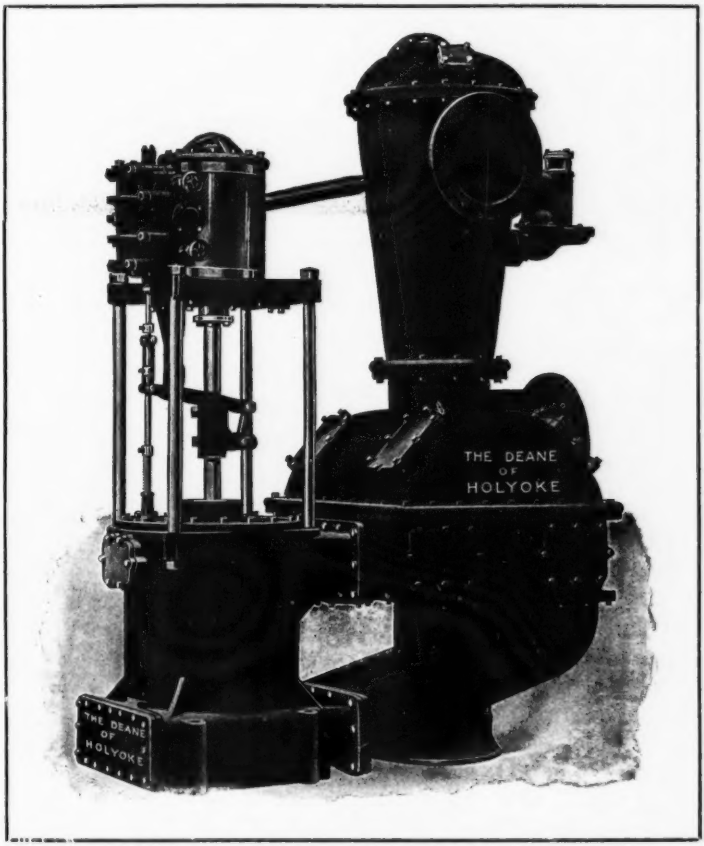


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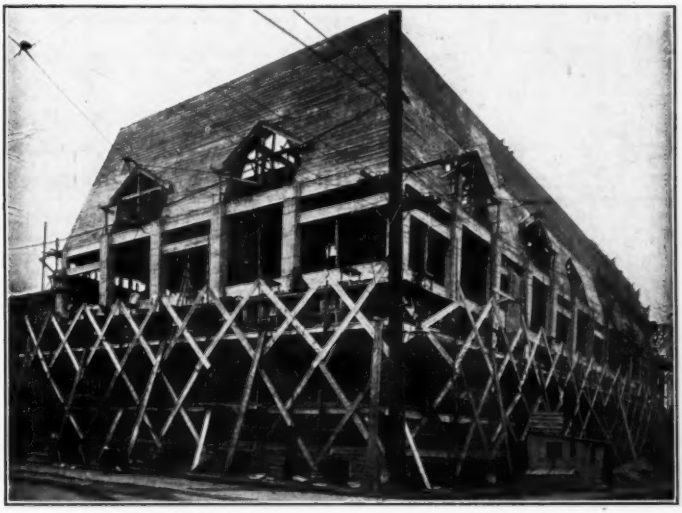

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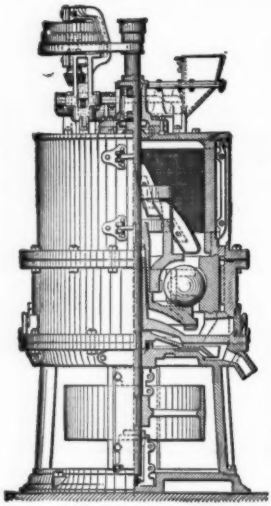

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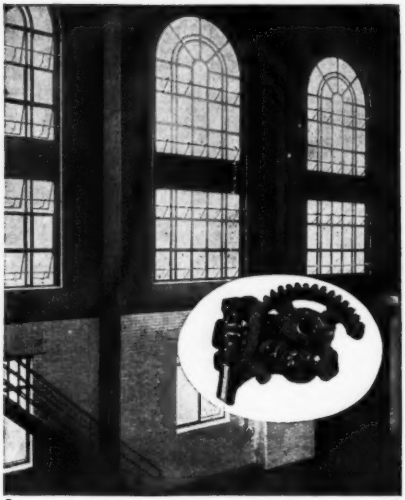

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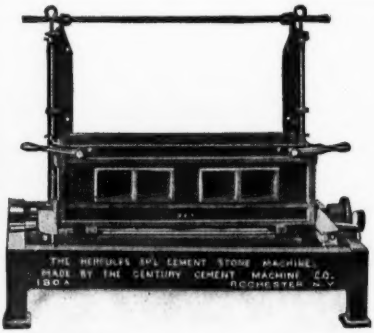


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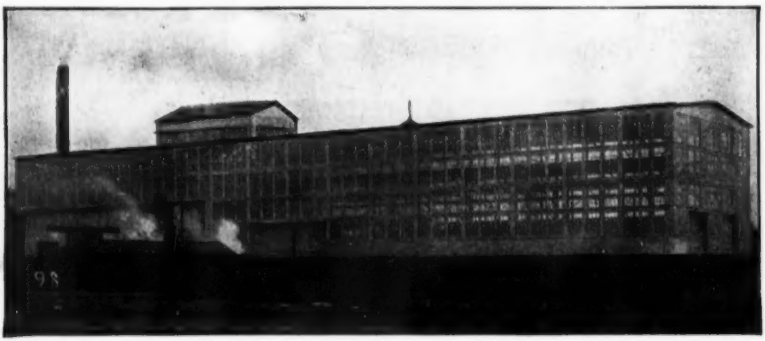

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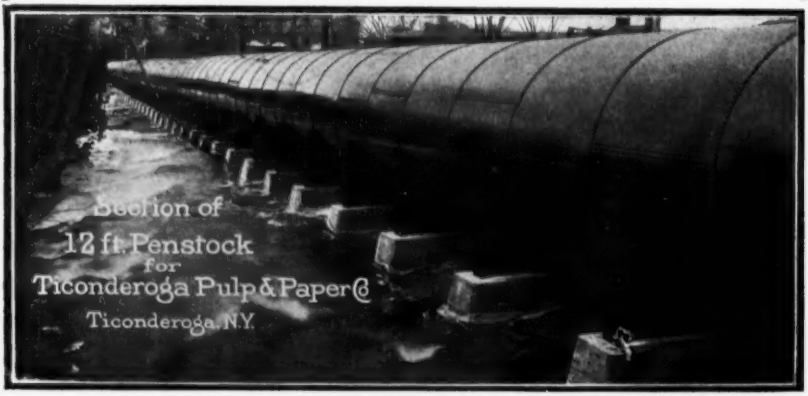

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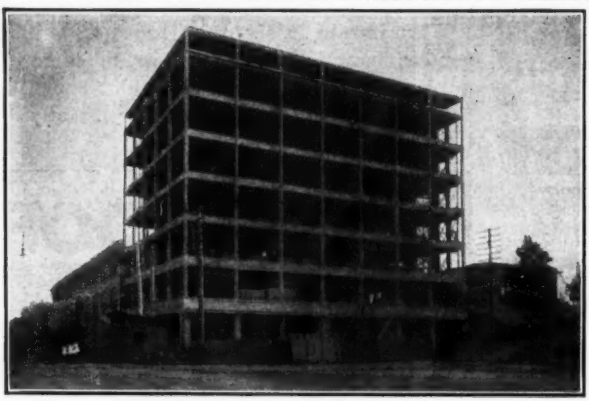

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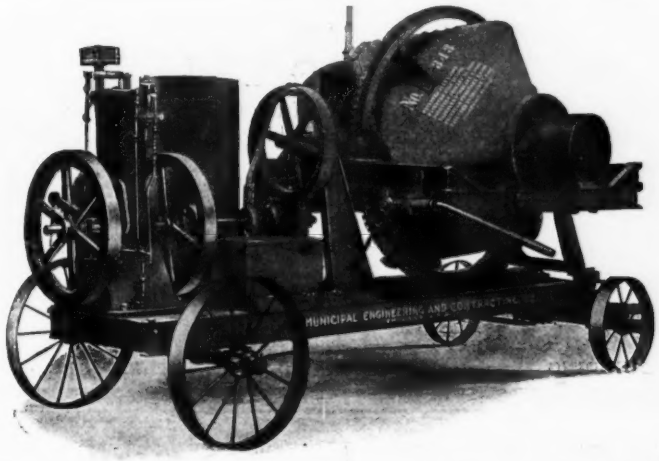


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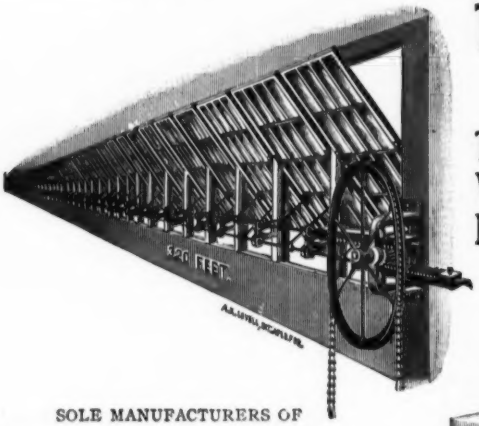


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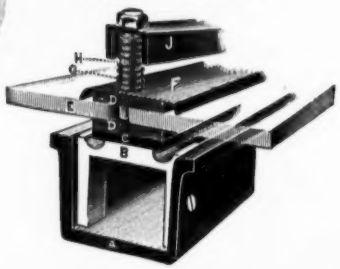

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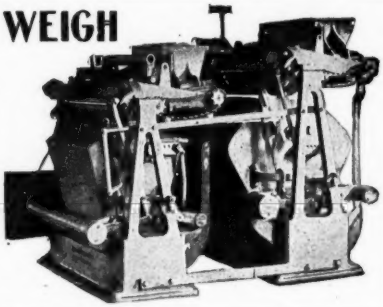

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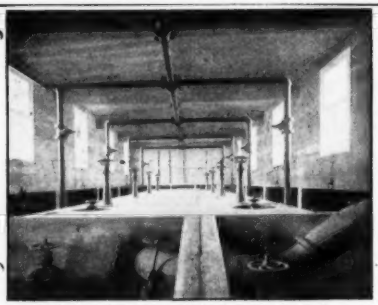

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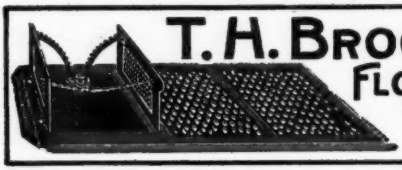

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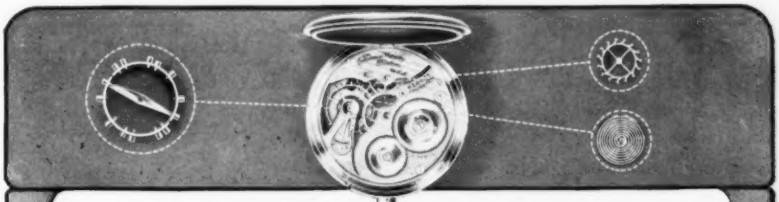

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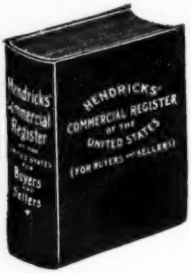
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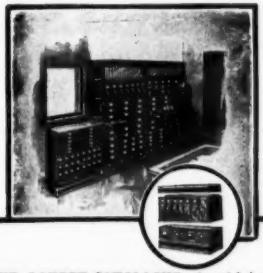

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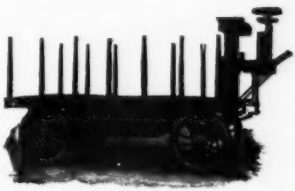

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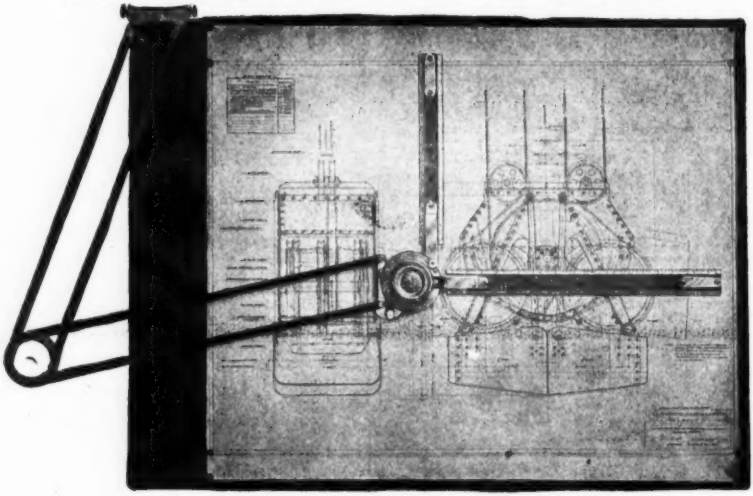

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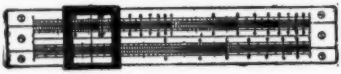

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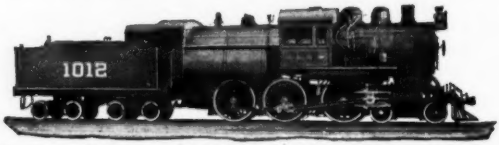


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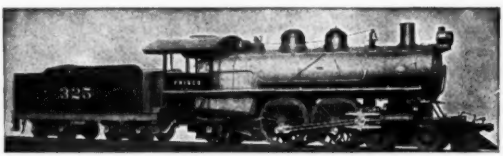


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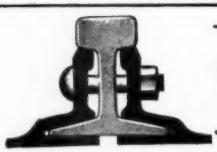

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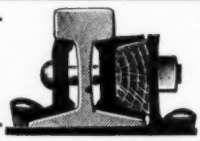

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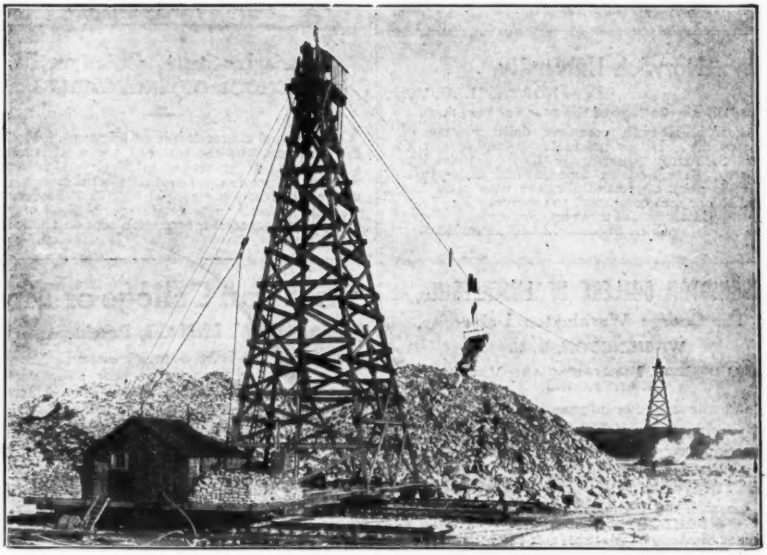

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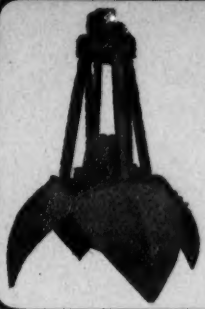

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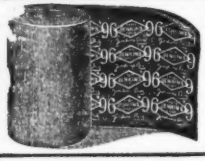

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